

# **FORT SAM HOUSTON DINING FACILITIES**

**San Antonio, Texas**

## **Energy Engineering Analysis Program (EEAP)**

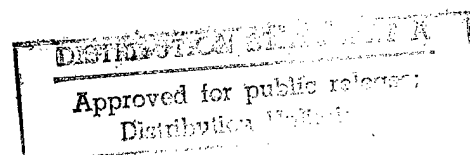
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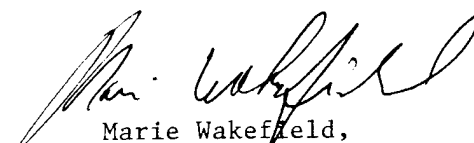


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## PREFACE

### BACKGROUND

This report was performed by the engineering firm of Carter & Burgess, Inc. under the Energy Engineering Analysis Program (EEAP), for the Fort Worth District Corps of Engineers. The purpose of this report is to identify and analyze energy conservation opportunities (ECO's) related to sixteen (16) dining facilities at Fort Sam Houston and five (5) dining facilities at Camp Bullis.

Energy Conservation opportunities (ECO's) identified in this report have been analyzed using sound, accepted fundamentals of engineering and the current utility rate schedules. Each recommended ECO is fully documented with calculations for energy savings, Savings to Investment Ratio (SIR) and simple payback.

This report is prepared in accordance with the detailed scope of work for Contract No. DACA63-91-D-0048, Delivery Order 0011 (Refer to Appendix F for complete scope of work). The BLAST Life Cycle Cost In Design (LCCID) program with the ECIP option was used to determine the Life Cycle Cost (LCC) and Savings to Investment Ratio (SIR) for each ECO.

### REPORT ORGANIZATION

This report has been organized to provide concise information related to the EEAP program presented herein. The report is broken into five sections. As follows;

Section 1	Introduction	
Section 2	Executive Summary	
Section 3	Utility Rate Schedule Analysis	
Section 4	Energy Conservation Analysis	
Section 5	Appendices	

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Section 2 presents a compilation of the data analyzed as well as a summary of the recommended Energy Conservation Opportunities.

Section 3 provides an analysis of the base utility rate structures for natural gas and electricity.

Section 4 presents a description of each facility audited along with the recommended ECO's with calculations for implementation cost, energy savings, maintenance savings and an ECIP summary sheet.

Section 5 is the report appendices which contains the following:

- Utility Rate Schedules
- Non-recommended ECO's
- Maintenance and Operational Recommendations
- Criteria and References
- Lighting Implementation Costs
- Scope of Work
- Symbol, Abbreviations and Conversion Factors
- Sample Software Calculations and Output Descriptions
- Implementation Documentation (DD Form 1391)

#### ACKNOWLEDGMENTS

The engineering staff of Carter & Burgess, Inc. would like to extend its thanks and appreciation to the FWD-COE and the DEH staff for assistance in gathering the building data and operating schedules necessary to complete this report.

## **EXECUTIVE SUMMARY**

### **INTRODUCTION**

This report was conducted to identify Energy Conservation Opportunities (ECO's) for twenty one (21) dining and kitchen facilities at Fort Sam Houston and Camp Bullis. All sources of energy consumption were considered in this report, including electricity, natural gas, and steam.

### **BUILDINGS/FACILITIES AUDITED**

#### **FORT SAM HOUSTON**

The dining/kitchen facilities at Fort Sam Houston analyzed for this report range in age from late 19th century to less than 10 years old. Construction types also vary widely. The majority of the facilities are constructed of concrete block walls with face brick, although wood frame, stone and stucco construction was also observed.

#### **CAMP BULLIS**

The dining/kitchen facilities at Camp Bullis are all of similar construction and were built in the early 1900's. These facilities are wood frame construction with lapboard exteriors.

### **PRESENT ENERGY CONSUMPTION**

Electricity and gas are not sub-metered to the building level. The gas supply is sub-metered randomly with some buildings having multiple meters and some meters feeding multiple buildings. The electrical usage is primarily metered thru two central sub-stations for the entire base. Therefore, the energy consumption information is based on the total base consumption as metered thru the two main sub-stations. (Refer to Table 1 for Base Year Utility Consumption).

**TABLE 1. BASE YEAR ENERGY CONSUMPTION DATA (Individual Meter)**

For prior 12 month period beginning September, 1992 and ending August, 1993.

Months	Electrical							Natural Gas	
	Consumption KWH	Demand Metered KW or KVA	Demand Charged KW or KVA	Power Factor	Fuel Adjustment \$/KWH	PCR or Cogeneration \$/KWH	Total Cost \$	Consumption Unit	Cost \$
January, 93	10,253,600	18,984	N/A	N/A	N/A	N/A	472,867	N/A	N/A
February, 93	9,085,600	18,984	N/A	N/A	N/A	N/A	417,992	N/A	N/A
March, 93	9,643,200	19,032	N/A	N/A	N/A	N/A	457,489	N/A	N/A
April, 93	10,156,000	22,912	N/A	N/A	N/A	N/A	510,107	N/A	N/A
May, 93	12,276,800	25,680	N/A	N/A	N/A	N/A	579,119	N/A	N/A
June, 93	15,378,400	30,336	N/A	N/A	N/A	N/A	756,066	N/A	N/A
July, 93	16,056,000	29,952	N/A	N/A	N/A	N/A	784,822	N/A	N/A
August, 93	16,658,400	30,960	N/A	N/A	N/A	N/A	801,535	N/A	N/A
September, 92	16,269,600	31,616	N/A	N/A	N/A	N/A	760,361	N/A	N/A
October, 92	13,277,600	31,312	N/A	N/A	N/A	N/A	629,878	N/A	N/A
November, 92	11,700,00	28,672	N/A	N/A	N/A	N/A	514,344	N/A	N/A
December, 92	9,788,800	19,800	N/A	N/A	N/A	N/A	445,411	N/A	N/A
Total	140,014,000.00	308,240.00	N/A	N/A	N/A	N/A	7,129,991.00	N/A	N/A

Company Name:	Electricity		Natural Gas	
	City Public Service		City Public Service	
	Company Rate Schedule:		Large Volume	

## COMPOSITE PROJECT SUMMARY

Listed in Table 2A is a compilation of all recommended ECO's. Tables 3A and 3B are compilations of all recommended ECO's studied as well as the analysis results for each ECO. Table 3A is sorted by building number and Table 3B is sorted by descending SIR. Also, shown in Table 2A is the ECO numbers and ECO descriptions analyzed for this report. A detailed summary of each ECO may be found with each building description and analysis.

## SUMMARY OF PROJECT

(All recommended ECO's included - see Table 4 for ECIP summary calculations)

KWH Savings:	<u>2,263.894</u>	KWH/yr
Demand Savings:	<u>7,241.9</u>	KW
Gas Savings:	<u>1,648.4</u>	MCF/yr
Cost Savings:	<u>\$ 140,319.00</u>	/Year
Implementation Cost:	<u>\$ 1,187,540.00</u>	
Simple Payback:	<u>6.2</u>	Years
Savings to Investment: Ratio (SIR)	<u>2.43</u>	

This report identified capital intensive projects which, if implemented, will result in the savings and costs summarized above. The savings for the recommended composite project listed above account for interdependence of savings of individual ECO's.

## SPECIAL CONSIDERATIONS

### UTILITY REBATES

City Public Service does not currently offer any utility rebate incentives for energy retrofit measures.

### MAINTENANCE AND OPERATION OF RETROFITTED SYSTEMS.

The combination of ECO's identified in this report will result in an overall decrease in maintenance labor and cost. This is due primarily to the installation of new lighting systems with increased service lives and a reduction in operating hours for mechanical equipment with the addition of automatic stop/start functions. Addition of automatic stop/start functions will also extend the useful life of the equipment.

TABLE 2A. SUMMARY OF RECOMMENDED ECO'S AND M & O'S

ENERGY CONSERVATION OPPORTUNITIES		ECO/ M & O	BUILDING #																					
			44	48	368	407	1350	1397	1395	1462	1520	1630	2205	2399	2521	2530	2652	2841	5105	5109	5107	5114	5124	GEN
I. ENVELOPE																								
A. ADDITIONAL INSULATION/SEALING																								
B. INSULATED GLASS OR GLAZING																								
C. WEATHER STRIPING AND CAULKING																								
II. HOT WATER																								
A. SHUTDOWN ENERGY TO WATER HEATER																								
B. ADDITION OF BOOSTER HEATERS AT MAJOR HW USERS																								
C. ADDITION OF INSTANTANEOUS WATER HEATERS																								
III. HEAT RECOVERY																								
A. HEAT RECOVERY FROM DISHWASHERS HOT WATER																								
B. HEAT RECLAIM FROM KITCHEN EXHAUST																								
C. WASTE HEAT RECOVERY																								
IV. HVAC																								
A. NIGHT SETBACK/SETUP THERMOSTAT			ECO	X																				
B. ECONOMIZER CYCLE(DRY BULB) 0																								
C. UPGRADE HVAC CONTROLS																								
1) ADD STOP/START FUNCTION TO HVAC EQUIPMENT																								
D. IMPROVE EFFICIENCY OF OPERATIONS			ECO																					
1) REPLACE CHILLER WITH HIGHER EFF/CFC FREE CHILLER																								
2) REPLACE RTU WITH HIGHER EFFICIENCY UNIT																								
E. BALANCE HVAC SYSTEM			M & O																					
F. INSTALL MAKE - UP AIR SUPPLY FOR KITCHEN AREAS			ECO																					
G. SHUT - OFF RANGE HOOD																								
H. THERMAL STORAGE																								
V. BOILER/STEAM																								
A. STEAM TRAP INSPECTION			M & O																					
B. INSULATE STEAM AND CONDENSATE LINES																								
VI. POWER																								
A. CONVERT TO ENERGY EFFICIENT/SMALLER MOTORS			M & O																					
VII. REDUCE/ENHANCE LIGHTING																								
A. PHOTOCELLS FOR LIGHTING																								
B. TIMERS FOR LIGHTING																								
C. REMOVE UNNEEDED LAMPS OR FIXTURES			ECO																					
D. REDUCE INDOOR/OUTDOOR LIGHTING TO AEL LEVELS			ECO	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E. LOWER LIGHT FIXTURES																								
F. IMPROVE REFLECTION WITH LIGHT COLORED CEILING/WALLS																								
VIII. IMPROVE LIGHTING CONTROLS																								
A. INSTALL OCCUPANCY SENSORS																								
B. SEPARATE SWITCHES TO CONTROL LIGHTING																								
IX. IMPROVE LIGHTING EFFICIENCY																								
A. REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS			ECO																					
B. REPLACE INCANDESCENT EXIT FIXTURES WITH LED			ECO																					
C. REPLACE STANDARD LAMPS WITH ENERGY SAVING LAMPS			ECO	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D. REPLACE STANDARD BALLAST WITH ENERGY SAVING BALLAST			ECO	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E. REPLACE EXISTING FIXTURES WITH HIGH EFF. FIXTURES			ECO																					
X. REFRIGERATION EQUIPMENT																								
A. IMPROVE EFFICIENCY OF REFRIGERATION EQUIPMENT																								
B. ADD PLASTIC AIR CURTAINS TO PREVENT INFILTRATION			M & O																					
XI. OTHER																								
A. REPLACE BOILERS WITH 99% EFFICIENT BOILER																								
B. REDUCE HW TEMPERATURE TO 140 °F			M & O																					
C. RESTORE OPERATION OF VENTILATION UNIT			M & O																					

TABLE 2B. SUMMARY OF NONRECOMMENDED ECO'S

ENERGY CONSERVATION OPPORTUNITIES		BUILDING #																				
I. ENVELOPE		44	48	368	407	1350	1367	1395	1462	1520	1630	2265	2399	2521	2530	2652	2841	5105	5106	5107	5114	5124
	A. ADDITIONAL INSULATION/SEALING	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. INSULATED GLASS OR GLAZING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. WEATHER STRIPING AND CAULKING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
II. HOT WATER																						
	A. SHUTDOWN ENERGY TO WATER HEATER	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. ADDITION OF BOOSTER HEATERS AT MAJOR HW USERS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. ADDITION OF INSTANTANEOUS WATER HEATERS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
III. HEAT RECOVERY																						
	A. HEAT RECOVERY FROM DISHWASHERS HOT WATER	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. HEAT RECLAIM FROM KITCHEN EXHAUST	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. WASTE HEAT RECOVERY	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IV. HVAC																						
	A. NIGHT SETBACK/SETUP THERMOSTAT	A		X	X	X	A	X	A	X	X	A			X	X		X	X	X	X	X
	B. ECONOMIZER CYCLE(DRY BULB)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. UPGRADE HVAC CONTROLS																					
	D. IMPROVE EFFICIENCY OF OPERATIONS	X	X	X		A	X	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	1) ADD STOP/START FUNCTION TO HVAC EQUIPMENT																					
	1) REPLACE CHILLER WITH HIGHER EFF/CFC FREE CHILLER	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2) REPLACE RTU WITH HIGHER EFFICIENCY UNIT	X	X	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	E. BALANCE HVAC SYSTEM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	F. INSTALL MAKE-UP AIR SUPPLY FOR KITCHEN AREAS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	G. SHUT-OFF RANGE HOOD	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	H. THERMAL STORAGE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
V. BOILER/STEAM																						
	A. STEAM TRAP INSPECTION	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. INSULATE STEAM AND CONDENSATE LINES	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VI. POWER																						
	A. CONVERT TO ENERGY EFFICIENT/SMALLER MOTORS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
VII. REDUCE/ENHANCE LIGHTING																						
	A. PHOTOCELLS FOR LIGHTING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. TIMERS FOR LIGHTING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. REMOVE UNEEDED LAMPS OR FIXTURES	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	D. REDUCE INDOOR/OUTDOOR LIGHTING TO AEI LEVELS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	E. LOWER LIGHT FIXTURES	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	F. IMPROVE REFLECTION WITH LIGHT COLORED CEILINGS/WALLS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VIII. IMPROVE LIGHTING CONTROLS																						
	A. INSTALL OCCUPANCY SENSORS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	B. SEPARATE SWITCHES TO CONTROL LIGHTING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IX. IMPROVE LIGHTING EFFICIENCY																						
	A. REPLACE INCANDESCENT LAMPS WITH COMPACT FLUORESCENTS	A			A	A	A	A	A		A				A							
	B. REPLACE INCANDESCENT EXIT FIXTURES WITH LED	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	C. REPLACE STANDARD LAMPS WITH ENERGY SAVING LAMPS	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	D. REPLACE STANDARD BALLAST WITH ENERGY SAVING BALLAST	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	E. REPLACE EXISTING FIXTURES WITH HIGH EFF. FIXTURES	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
X. REFRIGERATION EQUIPMENT																						
	A. IMPROVE EFFICIENCY OF REFRIGERATION EQUIPMENT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	B. ADD PLASTIC AIR CURTAINS TO PREVENT INFILTRATION	X	X			X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
XI. OTHER																						
	A. REPLACE BOILERS WITH 99% EFFICIENT BOILER	X	X	X	A	A	X	X	X	X	X	A	A	X	X	X	A	X	X	X	X	X
	B. REDUCE HW TEMPERATURE TO 140 °F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	C. RESTORE OPERATION OF VENTILATION UNIT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

A - NOT RECOMMENDED DUE TO ANALYSIS RESULTS

X - NOT RECOMMENDED DUE TO FIELD OBSERVATIONS/EXPERIENCE

A - NOT RECOMMENDED DUE TO ANALYSIS RESULTS

X = NOT RECOMMENDED DUE TO FIELD OBSERVATIONS/EXPERIENCE

A = NOT RECOMMENDED DUE TO ANALYSIS RESULTS

TABLE 3A. COMPOSITE ECO SUMMARY (BY BUILDING)

BUILDING NUMBER	ECO NUMBER	USAGE SAVINGS (KWH/YR)	DEMAND SAVINGS (KW/YR)	GAS SAVINGS (MCF/YR)	MAINT. SAVINGS (\$/YR)	COST SAVINGS (\$/YR)	IMPLEMENTATION COST (\$)	SIMPLE PAYBACK (YEARS)	SAVING TO INV. RATIO (SIR)
BUILDING 44	IV.A	472	0	3.5	-\$5.00	\$29.00	\$122.00	5.1	2.7
BUILDING 44	VII.C,D & IX.C, D	8,409	18.6	N/A	\$33.00	\$460.00	\$2,117.00	4.6	2.28
BUILDING 48	IX.A	709	2.6	N/A		\$54.00	\$89.00	1.7	5.41
BUILDING 368	IV.A	2,649	0.0	19.8	-\$15.00	\$164.00	\$363.00	2.4	5.5
BUILDING 368	VII.C,D & IX.A, C, D	19,807	43.9	N/A	\$110.00	\$1,116.00	\$2,244.00	2	5.07
BUILDING 407	IV.C.1	181,265	0.0	660.6	-\$45.00	\$8,781.00	\$2,233.00	0.3	34.9
BUILDING 407	VII.C, D & IX.A, B, C, D	12,315	53.2	N/A	\$214.00	\$1,012.00	\$4,557.00	4.5	1.97
BUILDING 1350	IV.D.1)	126,750	528.0	0.0		\$8,084.00	\$231,987.00	11.8	1.05
BUILDING 1350	VII.C,D, & IX.B,C,D.	23,724	67.0	N/A	\$289.00	\$2,783.00	\$9,130.00	3.3	3.45
BUILDING 1387	VII.C,D, & IX.A,B,C,D	19,311	29.9	N/A	\$127.00	\$1,022.00	\$2,592.00	2.5	4.46
BUILDING 1395	IV.D.1)	123,020	1,152.0	N/A		\$12,302.00	\$159,262.00	8.2	1.81
BUILDING 1395	VII.C,D & IX.A,B,C,D	42,637	53.7	N/A	\$286.00	\$2,179.00	\$4,950.00	2.2	5.08
BUILDING 1462	VII.C,D & IX.B,C,D	8,760	15.4	N/A	\$37.00	\$455.00	\$1,037.00	2.3	4.96
BUILDING 1520	VII.C, D, & IX.A,B,C,D	12,030	26.8	N/A	\$52.00	\$664.00	\$2,447.00	3.7	3.08
BUILDING 1630	VII.C,D & IX.A,C,D	2,397	5.5	N/A	\$10.00	\$139.00	\$357.00	2.7	4.21
BUILDING 2265	IV.D.1)	424,595	1,740.0	N/A		\$26,888.00	\$338,516.00	7.7	2.02
BUILDING 2265	VII.C,D, & IX.B,C,D	49,856	46.7	N/A	\$242.00	\$2,349.00	\$2,723.00	1.2	9.77
BUILDING 2399	IV.A	7,528	0.0	89.1	-\$15.00	\$575.00	\$363.00	0.6	21.15
BUILDING 2399	IV.D.1)	826,098	3,182.0	N/A		\$54,626.00	\$365,824.00	5.1	3.02
BUILDING 2399	IV.F.1.	41,614	0.0	617.0		\$3,604.00	\$31,268.00	8.7	2.09
BUILDING 2399	IV.F.2.	4,776	0.0	70.8		\$414.00	\$3,976.00	9.6	1.89
BUILDING 2399	VII.C,D & IX.A,B,C,D	18,019	28.4	N/A	\$269.00	\$1,574.00	\$8,895.00	5.7	2
BUILDING 2521	IV.A	278	0.0	2.1	-\$5.00	\$17.00	\$122.00	10	1.42
BUILDING 2521	VII.C,D & IX.A,C,D	2,994	13.3	N/A	\$15.00	\$212.00	\$666.00	4.1	2.75
BUILDING 2530	VII.C,D & IX.B,C,D	5,444	9.1	N/A	\$23.00	\$280.00	\$591.00	2.1	5.98
BUILDING 2652	IV.C.1)	41,114	0.0	39.0		\$1,613.00	\$2,292.00	1.4	8.49
BUILDING 2652	VII.C,D & IX.A,B,C,D	8,090	11.7	N/A	\$36.00	\$406.00	\$1,588.00	3.9	2.89
BUILDING 2841	IV.A	2,000	0.0	23.5	-\$10.00	\$152.00	\$242.00	1.7	8.13
BUILDING 2841	VII.C,D, & IX.A,B,C,D,E	111,658	185.9	N/A	\$1,703.00	\$6,903.00	\$4,343.00	0.6	18.1
BUILDING 5105	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A
BUILDING 5107	IV.C.1)	22,613	0.0	N/A	-\$15.00	\$814.00	\$425.00	0.5	22.17
BUILDING 5107	VII.C,D, & IX.A,B,C,D	12,962	18.2	N/A	\$66.00	\$654.00	\$2,119.00	3.2	3.49
BUILDING 5114	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A
BUILDING 5124	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL		2,263,894	7,241.9	1,525.2	\$3,402.00	\$140,319.00	\$1,187,540.00	6.20	2.43



TABLE 3B. COMPOSITE ECO SUMMARY (BY SIR)

BUILDING NUMBER	ECO NUMBER	USAGE SAVINGS (KWH/YR)	DEMAND SAVINGS (KW/YR)	GAS SAVINGS (MCF/YR)	MAINT. SAVINGS (\$/YR)	COST SAVINGS (\$/YR)	IMPLEMENTATION COST (\$)	SIMPLE PAYBACK (YEARS)	SAVING TO INV. RATIO (SIR)
BUILDING 407	IV.C.1	181,265	0.0	660.6	-\$45.00	\$8,781.00	\$2,233.00	0.3	34.9
BUILDING 5107	IV.C.1	22,613	0.0	N/A	-\$15.00	\$814.00	\$425.00	0.5	22.17
BUILDING 2399	IV.A	7,528	0.0	89.1	-\$15.00	\$575.00	\$363.00	0.6	21.15
BUILDING 2841	VII.C.D. & IX.A,B,C,D,E	111,658	185.9	N/A	\$1,703.00	\$6,903.00	\$4,343.00	0.6	18.1
BUILDING 2652	VII.C.D. & IX.B,C,D	49,856	46.7	N/A	\$242.00	\$2,349.00	\$2,723.00	1.2	9.77
BUILDING 2652	IV.C.1	41,114	0.0	39.0		\$1,613.00	\$2,292.00	1.4	8.49
BUILDING 2841	IV.A	2,000	0.0	23.5	-\$10.00	\$152.00	\$242.00	1.7	8.13
BUILDING 368	IV.A	2,649	0.0	19.6	-\$15.00	\$184.00	\$363.00	2.4	5.5
BUILDING 48	IX.A	709	2.6	N/A		\$54.00	\$89.00	1.7	5.41
BUILDING 2530	VII. C,D & IX.B,C,D	5,444	9.1	N/A	\$23.00	\$280.00	\$591.00	2.1	5.38
BUILDING 1395	VII.C,D & IX.A,B,C,D	42,637	53.7	N/A	\$286.00	\$2,179.00	\$4,850.00	2.2	5.08
BUILDING 368	VII.C,D & IX.A, C, D	19,807	43.9	N/A	\$116.00	\$1,116.00	\$2,244.00	2	5.07
BUILDING 1462	VII.C,D & IX.B,C,D	8,760	15.4	N/A	\$37.00	\$455.00	\$1,037.00	2.3	4.98
BUILDING 1387	VII C,D. & IX.A,B,C,D	19,311	29.3	N/A	\$127.00	\$1,022.00	\$2,592.00	2.5	4.46
BUILDING 1630	VII.C,D & IX.A,C,D	2,397	5.5	N/A	\$10.00	\$133.00	\$357.00	2.7	4.21
BUILDING 1507	VII.C,D. & IX.A,B,C,D	12,962	18.2	N/A	\$66.00	\$654.00	\$2,119.00	3.2	3.49
BUILDING 1350	VII.C,D. & IX.B,C,D	23,724	67.0	N/A	\$289.00	\$2,783.00	\$9,130.00	3.3	3.45
BUILDING 1520	VII C, D. & IX.A,B,C,D	12,030	26.8	N/A	\$52.00	\$684.00	\$2,447.00	3.7	3.06
BUILDING 2399	IV. D. 1)	926,098	3,192.0	N/A		\$54,626.00	\$365,824.00	5.1	3.02
BUILDING 2652	VIII.C,D & IX.A,B,C,D	8,080	11.7	N/A	\$36.00	\$406.00	\$1,586.00	3.9	2.89
BUILDING 2521	VII.C,D & IX.A,C,D	2,994	13.3	N/A	\$15.00	\$212.00	\$866.00	4.1	2.75
BUILDING 44	IV.A	472	0	3.5	-\$5.00	\$29.00	\$122.00	5.1	2.7
BUILDING 44	VII.C,D & IX C, D	8,409	18.6	N/A	\$33.00	\$460.00	\$2,117.00	4.6	2.28
BUILDING 2399	IV. F. 1.	41,614	0.0	617.0		\$3,604.00	\$31,268.00	8.7	2.09
BUILDING 2265	IV.D.1)	424,595	1,740.0	N/A		\$26,888.00	\$338,516.00	7.7	2.02
BUILDING 2399	VII.C,D & IX.A,B,C,D	18,019	28.4	N/A	\$269.00	\$1,574.00	\$8,895.00	5.7	2
BUILDING 407	VII.C, D & IX A, B, C, D	12,315	53.2	N/A	\$214.00	\$1,012.00	\$4,557.00	4.5	1.97
BUILDING 2399	IV. F. 2.	4,776	0.0	70.8		\$414.00	\$3,976.00	8.6	1.89
BUILDING 1395	IV.D. 1)	123,020	1,152.0	N/A		\$12,302.00	\$159,262.00	8.2	1.81
BUILDING 2521	IV.A	278	0.0	2.1	-\$5.00	\$17.00	\$122.00	10	1.42
BUILDING 1350	IV.D.1)	126,750	528.0	0.0		\$8,084.00	\$231,987.00	11.8	1.05
BUILDING 5114	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BUILDING 5105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BUILDING 5124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL		2,263,894	7,241.9	1,525.2	\$3,402.00	\$140,319.00	\$1,187,540.00	6.20	2.43

# TABLE 4. ECIP SUMMARY

## LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: COMPOSITE ECO SUMMARY  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	<u>\$1,065,058</u>	
B. SIOH	<u>\$58,578</u>	
C. DESIGN COST	<u>\$63,903</u>	
D. TOTAL COST (1A+1B+1C)	<u>\$1,187,540</u>	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	<u>\$0</u>	
F. PUBLIC UTILITY COMPANY REBATE	<u>\$0</u>	
G. TOTAL INVESTMENT (1D-1E-1F)		<u>\$1,187,540</u>

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	<u>\$10.55</u>	<u>7726.67</u>	<u>\$81,516</u>	<u>14.65</u>	<u>\$1,194,215</u>
B. DIST			<u>\$0</u>	<u>17.70</u>	<u>\$0</u>
C. RESID			<u>\$0</u>	<u>20.99</u>	<u>\$0</u>
D. NG	<u>\$3.31</u>	<u>1699.50</u>	<u>\$5,625</u>	<u>20.60</u>	<u>\$115,882</u>
E. PPG			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
F. COAL			<u>\$0</u>	<u>16.32</u>	<u>\$0</u>
G. SOLAR			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
H. GEOTH			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
I. BIOMA			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
J. REFUS			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
K. WIND			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
L. OTHER			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
M. DEMAND SAVINGS			<u>\$48,279</u>	<u>13.59</u>	<u>\$656,109</u>
N. TOTAL		<u>9426.17</u>	<u>\$135,421</u>		<u>\$1,966,206</u>

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	<u>\$3,402</u>	
1. DISCOUNT FACTOR (TABLE A)		<u>13.59</u>
2. DISCOUNTED SAVINGS/COST (3A X 3A1)		<u>\$46,233</u>

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$429,288	1	0.96	\$412,116
b. N/A	\$0	2	0.92	\$0
c. N/A	\$338,516	3	0.89	\$301,279
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$51,000	13	0.6	\$30,600
n. N/A	\$0	14	0.58	\$0
o. Chiller	\$231,987	15	0.56	\$129,913
p. TOTAL	\$1,050,791			\$873,908

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$920,142

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 6.2 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$2,886,347

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 2.43

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 8.7%

## METHODOLOGY

This analysis was conducted with the use of four different software packages. These packages are SimpCalc, Flex, Trace and Lotus. Each software package was utilized for different ECO types. The following is a description of the software packages and the corresponding ECO's which were analyzed. Refer to Appendix H for example software output summaries with descriptions of the results as well as sample calculations.

### **SIMPCALC**

Simplified Energy Conservation Opportunity Calculation System which was developed for the Texas LoanSTAR (Saving Taxes And Resources) program through the Governor's Energy Office and the Department of Energy. This software was utilized to perform energy savings calculations for the following ECO types:

#### **IV. HVAC**

- A. Night setback/setup thermostat.
- C. Upgrade HVAC controls.
  - 1. Add stop/start function to HVAC equipment.
- D. Improve efficiency of operations.
  - 2. Replace RTU with higher efficiency unit.

#### **VI. Power**

- A. Convert to energy efficient/smaller motors.

### **FLEX**

Federal Lighting Energy eXpert (FLEX) program which was developed by the National Renewable Energy Laboratory for the Department of Energy. This software was developed to analyze lighting retrofit systems and is capable of calculating lighting energy savings, HVAC energy savings, implementation cost (refer to Appendix E for input lighting implementation costs), and maintenance savings. This software will also calculate the footcandle levels before and after retrofit. This software was utilized to perform energy savings calculations for the following ECO type:

#### **VII. Reduce/Enhance Lighting**

- C. Remove unneeded lamps or fixtures.
- D. Reduce indoor/outdoor lighting to AEI levels.

## **IX. Improve Lighting Efficiency**

- A. Replace incandescent lamps with compact fluorescents.
- B. Replace incandescent exit fixtures with LED.
- C. Replace standard lamps with energy saving lamps.
- D. Replace standard ballasts with energy saving ballasts.
- E. Replace existing fixtures with high efficiency fixtures.

## **TRACE**

Trace is a building energy analysis program. It is designed to calculate energy consumption, operating costs and equipment paybacks for HVAC systems. This software was utilized to perform energy savings calculations for the following ECO types:

### **IV. HVAC**

- C. Upgrade HVAC controls.
  - 1. Add stop/start function to HVAC equipment.
- D. Improve efficiency of operations.
  - 1. Replace chiller with higher efficiency.

## **LOTUS**

Lotus is a spreadsheet program. This software was utilized to perform calculations for the Bin Method (refer to Appendix H) for ECO type as follows:

### **IV. HVAC**

- F. Install make-up air supply for kitchen areas.

## **RECOMMENDED ECO'S**

All recommended ECO's are listed after each building description. All calculations, references, manufacturers data, implementation costs and ECIP summary calculations are included for each ECO.

## **NON-RECOMMENDED ECO'S**

All non-recommended ECO's and justification references are included in Appendix B.

## **ASSUMPTIONS**

All assumptions are listed with each individual ECO.

## CONCLUSIONS

The results of this analysis indicate that the ECO's recommended result in a project which is eligible of ECIP funding. The approximate implementation cost for the project is \$1,187,540.00 with a simple payback of 6.2 years and an SIR of 2.43. The adjusted internal rate of return is 8.7%.

## UTILITY RATE SCHEDULE ANALYSIS

### ELECTRIC UTILITY RATE SCHEDULE ANALYSIS

NAME OF UTILITY: City Public Service

RATE SCHEDULE ANALYZED: Large Lighting and Power Service  
(See Appendix A)

#### SUMMARY OF BILLING COMPONENT CHARGES:

Customer Charge: \$130.00

	<u>On-Peak Months</u>	<u>Off-Peak Months</u>
Energy Charge:	\$ .036 /KWH	\$ .036 /KWH
Demand Charge:	\$7.50 /KW	\$6.25 /KW

#### AVOIDED COST OF ENERGY TO BE USED IN CALCULATIONS:

CHARGE	PEAK	UTILITY COST	SITE COST
Energy Charge	On-Peak	\$.036/KWH	\$10.55/MBTU
	Off-Peak	\$.036/KWH	
Demand Charge	On-Peak	\$7.50/KW	--
	Off-Peak	\$6.25/KW	

Site Cost was obtained using a conversion factor of .003413 MBTU/KWH.

#### COMMENTS:

No incentive or rebates for energy retrofit measures.

## GAS UTILITY RATE SCHEDULE ANALYSIS

NAME OF UTILITY: City Public Service

RATE SCHEDULE ANALYZED: Large Volume Gas

(See Appendix A)

### SUMMARY OF BILLING COMPONENT CHARGES:

Minimum Charge: \$325.00/month per meter

	<u>December-March</u>	<u>April-November</u>
Demand Charge:	\$0.80 per CCF/Day	\$.64 per CCF/Day
Energy Charge:	\$.265 per CCF	\$.265 per CCF

### AVOIDED COST OF ENERGY TO BE USED IN CALCULATIONS:

Charge	Utility Cost	Site Cost
Gas Usage	\$ 3.41/KCF*	\$3.31/MBTU

Site cost was obtained using a conversion factor of 1.031 MBTU/KCF.

\*Utility cost was based on an average cost of gas based on Historical Billings (See Appendix A).



## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 44 - SNACK BAR**

Building 44 is primarily a one story building with a total of 95,000 square feet. The snack bar is contained within this facility and consists of approximately 2,000 square feet.

The operating hours are from 6:00 am to 2:00 pm, 5 days per week.

The lighting system is primarily fluorescent.

The mechanical system consists of a 3 ton packaged DX rooftop unit with gas heating and a kitchen exhaust hood.

Hot water is supplied by the central building, gas fired, domestic hot water boiler. There is no dishwashing equipment and all dishes and utensils are disposable.

The following ECO's are recommended for Building 44:

1. IV. A - Night setback/setup thermostat
2. VII. D - Reduce indoor/outdoor lighting to AEI levels
3. IX. C - Replace standard lamps with energy saving lamps
4. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 44

ECO NO: IV.A.

ECO NAME: Night setback/setup thermostat.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>472</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>3.5</u>	MCF/yr
Cost Savings:	<u>\$ 29.00</u>	/yr
Implementation Cost:	<u>\$ 122.00</u>	
Simple Payback:	<u>4.2</u>	Years
Savings to Investment: Ratio (SIR):	<u>3.15</u>	

#### ECO DESCRIPTION:

Currently, a manual thermostat is used to control the packaged DX rooftop unit which serves the snack bar. This ECO analyzes the installation of a programmable night setback/setup thermostat to reduce energy consumption during unoccupied periods.

#### COST SAVINGS CALCULATIONS:

(Refer to following SimpCalc Calculations)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### MAINTENANCE COSTS:

Maintenance costs of \$5.00/year is included in the LCCA for programming, battery replacement and failures.

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

TEXAS LoanSTAR Program - ECRM Simplified Calculation Ver 2.0

11/08/93

SimpCalc 2.0 SUMMARY (by FORM) - FORT SAM HOUSTON

Page 1

Form	Facility	ECRM Desc.	Page	KWH/Yr	KW	MCF/yr	mmBtu/Yr	\$/Yr	Imp.Cost	PayBack
C7-01	BLDG 0044 SNACK BAR	Prog Thermostat	1	472	.00	3.5	5.2	29	122	4.2
		*** SUB-TOTAL ***		472	.00	3.5	5.2	29	122	4.2
	** GRAND TOTAL **			472	.00	3.5	5.2	29	122	4.2

11/08/93

Consolidated ECRM Detail - FORT SAM HOUSTON

Page 1

C7-001 Programmable Thermostats - BLDG 0044 SNACK BAR

(G)

Cost Source: means cost estimating

Description: Install night setback/setup thermostat.

A) .15 BTU/hr-ft-F U-Value of Walls  
 B) 0 Sq.Ft. Wall Area (includes windows and doors)  
 C) .05 BTU/hr-ft-F U-Value of Roof  
 D) 2074 Sq.Ft. Roof Area  
 E) 70 Degree/F Heating Season Thermostat Setpoint  
 F) 55 Degree/F Heating Season Thermostat Setback Setpoint  
 G) 1800 Hours/yr Heating Season Setback Hours  
     = 12 Hrs/day x 150 Days/yr  
 H) 74 Degree/F Cooling Season Thermostat Setpoint  
 I) 90 Degree/F Cooling Season Thermostat Setback Setpoint  
 J) 2400 Hours/yr Cooling Season Setback Hours  
     = 12 Hrs/day x 200 Days/yr  
 K) .7500 Heating Equipment Efficiency (Table 2)  
 L) \$ 3.41 /MCF Cost per MCF  
 M) 8.57 BTUH/Watt EER of Air Conditioning Unit (Table 1)  
 N) \$ .0360 /KWH Cost per KWH - Summer  
 O) \$ 122 Installed Cost = 1 Thermostats x \$ 122/stat  
  
 P) 104 BTU/hf-F Total Envelope UA-Value  
 Q) 2.8 mmBTU/yr Heating Load Reduction  
 R) \$ 12 Heating Cost Reduction  
 S) 4.0 mmBTU/yr Cooling Load Reduction  
 T) \$ 17 /year Cooling Cost Reduction  
 U) \$ 29 /year Annual Cost Savings  
 V) 4.2 years Simple Payback

## CARTER & BURGESS COST ESTIMATING ANALYSIS

PROJECT NAME: FORT SAM HOUSTON EEAP

PROJECT NO: 91109912F

**PROJECT LOCATION: SAN ANTONIO, TEXAS**

**ESTIMATOR: S.P. CLARK**

<b>SUBMITTAL:</b>	<b>35.0%</b>
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**DATE:** 23-Oct-93

ECO NO/ BUILDING: IV. A. / BLDG 0044

CHECKED BY: DJY

[illegible]

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0044 - ECO IV. A. - NIGHT SETBACK/SETUP THERMOSTAT  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

**1. INVESTMENT COSTS:**

A. CONSTRUCTION COST	\$109				
B. SIOH	\$6				
C. DESIGN COST	\$7				
D. TOTAL COST (1A+1B+1C)	\$122				
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0			
F. PUBLIC UTILITY COMPANY REBATE		\$0			
G. TOTAL INVESTMENT (1D-1E-1F)				\$122	

**2. ENERGY SAVINGS (+)/COST(-):**

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	1.61	\$17	11.77	\$200
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	3.61	\$12	15.34	\$183
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. OTHER			\$0	11.12	\$0
M. DEMAND SAVINGS			\$0	11.12	\$0
N. TOTAL		5.22	\$29		\$383

**3. NON ENERGY SAVINGS (+) OR COST (-):**

A. ANNUAL RECURRING (+/-)	-\$5				
1. DISCOUNT FACTOR (TABLE A)		11.1			
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			-\$56		

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** - \$56

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 5.1 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$328

**6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G:** 2.70

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 11.1%



## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 44

ECO NO: VII. D. & IX C.,D.

ECO NAME: Improve lighting efficiency

#### SUMMARY DATA (DEPENDENT):

KWH Savings: 8.409 KWH/yr  
Demand Savings: 18.6 KW/yr  
Gas Savings: N/A MCF/yr  
Cost Savings: \$ 460.00 /yr  
Implementation Cost: \$ 2,117.00  
Simple Payback: 4.6 Years  
Savings to Investment:  
Ratio (SIR): 2.28

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting system to improve efficiency while maintaining or increasing lighting levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
12	2-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
8	4-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
20	2-Lamp, 8' Fluor.	Retrofit w/T8 lamps and electronic ballasts.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= [(4.49 \text{ KW} - 2.94 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (4.49 \text{ KW} - 2.94 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW}] \\ &= \$124.00/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD00044A	6610	8808	22942	1688	3492	4.160	3.515	2117	945	19880	70	1463
*BLD00044B	10101	0	31750	2336	0	0.000	0.000	0	1395	30355	103	2234

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD00044A	POST RETROFIT CONDITIONS
BLD00044B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044A.WBR  
 Date: 10/16/1993

Lighting Annual : 6610 kWh  
 Lighting Capacity : 2.938 kW  
 Annual Cooling Effect : 9322 kWh  
 Annual Heating Effect : 944 kWh  
 Total Surveyed Floor Area: 2199 Sqft  
 Percent Survey Completed : 219900 %  
 Lighting Power Density : 1.336 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2117	8447	945	11595	-162	22942
AVLCC \$	156	622	70	853	-12	1688

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044A.LLR

Date: 10/16/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
-----	-----	-----	-----	-----	-----	-----
Calculated	44.7	5.3	23.3	16.77	5-kitchen	1-storage
Measured	45.7	0.0	16.8	19.06	5-kitchen	2-Corr
Required	50.0	5.0	26.0	22.75	3-stor	1-storage

Foot Candle						
Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
-----	-----	-----	-----	-----	-----	-----
Calc - Req.	24.5	-20.2	-2.7	17.07	4-dining	3-stor
Meas - Req.	18.6	-50.0	-9.2	27.05	4-dining	3-stor

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: suspended wrap

Rooms Served: 1  
Floor Area: 272 SqFt  
Possible kW: 0.126  
Working kW: 0.126  
Capacity kW: 0.126  
Lighting: 283 Annual kWh  
Heating: 40 Annual kWh  
Cooling: 401 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.462 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	361	35	505	-7	976
AVLCC \$	27	3	37	-1	72

System Number: 2      Descrip: 2x4 lay-in

Rooms Served: 2  
Floor Area: 1556 SqFt  
Possible kW: 0.628  
Working kW: 0.628  
Capacity kW: 0.628  
Lighting: 1413 Annual kWh  
Heating: 202 Annual kWh  
Cooling: 2004 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.404 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	20	10.0
Working	10	20	10.0
Capacity	10	20	10.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1806	177	2524	-35	4882
AVLCC \$	133	13	186	-3	359

System Number: 3      Descrip: 2x4 recessed, acrylic

Rooms Served: 2  
 Floor Area: 371 SqFt  
 Possible kW: 0.928  
 Working kW: 0.899  
 Capacity kW: 0.928  
 Lighting: 2088 Annual kWh  
 Heating: 298 Annual kWh  
 Cooling: 2910 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 2.423 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	8	32	8.0
Working	8	31	7.0
Capacity	8	32	8.0
Disconnected	0	0	0.0
Broken/Burned	0	1	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2668	221	3520	-51	6782
AVLCC \$	196	16	259	-4	499

System Number: 4      Descrip: 8' industrial w/ 1/2' plastic

Rooms Served: 1  
 Floor Area: 1360 SqFt  
 Possible kW: 1.256  
 Working kW: 1.256  
 Capacity kW: 1.256  
 Lighting: 2826 Annual kWh  
 Heating: 404 Annual kWh  
 Cooling: 4007 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 0.924 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	20	40	20.0
Working	20	40	20.0
Capacity	20	40	20.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3612	512	5047	-69	10302
AVLCC \$	266	38	371	-5	758

Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: M:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	SYSTEM1	Work Watts	Pot. Watts	Watt sqft	SYSTEM2	Work Watts	Pot. Watts	Watt sqft	SYSTEM3	Work Watts	Pot. Watts	Watt sqft	Watt Meas.	Calc.	Req.
1-storage	1	1	272	1 suspended	126	126	0.46		126	126	0.46		126	126	0.46	14.5	5.3	5.0
2-Corr	1	1	196	2 2x4 lay-in	126	126	0.64		126	126	0.64		126	126	0.64	0.0	7.1	20.0
3-stor	1	1	147	1 2x4 recess	319	348	2.37		319	348	2.37		319	348	2.37	0.0	29.8	50.0
4-dining	1	1	1360	15 2x4 lay-in	502	502	0.37	8' industr	1256	1256	0.92		1758	1758	1.29	23.6	29.5	5.0
5-kitchen	1	1	224	1 2x4 recess	580	580	2.59		580	580	2.59		580	580	2.59	45.7	44.7	50.0

Total Rooms : 5  
 Total Area Sqft : 2199  
 Total People : 20  
 Total Working kW : 2,909  
 Total Potential kW : 2,938  
 Power Density W/sqft : 1.336



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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044B.WBR

Date: 10/16/1993

Lighting Annual : 10101 kWh  
 Lighting Capacity : 4.490 kW  
 Annual Cooling Effect : 14240 kWh  
 Annual Heating Effect : 1443 kWh  
 Total Surveyed Floor Area: 2199 SqFt  
 Percent Survey Completed : 220 %  
 Lighting Power Density : 2.042 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
	-----	-----	-----	-----	-----	-----
PVLCC \$	0	12909	1395	17694	-248	31750
AVLCC \$	0	950	103	1302	-18	2336

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0044\BLD0044B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: suspended wrap

Rooms Served: 1  
Floor Area: 272 SqFt  
Possible kW: 0.159  
Working kW: 0.159  
Capacity kW: 0.159  
Lighting: 358 Annual kWh  
Heating: 51 Annual kWh  
Cooling: 507 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.585 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	457	61	639	-9	1148
AVLCC \$	34	4	47	-1	84

System Number: 2      Descrip: 2x4 lay-in

Rooms Served: 2  
Floor Area: 1556 SqFt  
Possible kW: 0.875  
Working kW: 0.716  
Capacity kW: 0.875  
Lighting: 1968 Annual kWh  
Heating: 281 Annual kWh  
Cooling: 2790 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.460 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	11	22	11.0
Working	10	18	8.0
Capacity	11	22	11.0
Disconnected	0	0	0.0
Broken/Burned	1	2	1.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2515	334	3514	-48	6314
AVLCC \$	185	25	259	-4	465

System Number: 3      Descrip: 2x4 recessed, acrylic

Rooms Served: 2  
 Floor Area: 371 SqFt  
 Possible kW: 1.536  
 Working kW: 1.488  
 Capacity kW: 1.536  
 Lighting: 3456 Annual kWh  
 Heating: 494 Annual kWh  
 Cooling: 4817 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 4.011 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	8	32	8.0
Working	8	31	7.0
Capacity	8	32	8.0
Disconnected	0	0	0.0
Broken/Burned	0	1	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4417	404	5826	-85	10561
AVLCC \$	325	30	429	-6	777

System Number: 5      Descrip: 8' industrial w/ 1/2'plastic

Rooms Served: 1  
 Floor Area: 1360 SqFt  
 Possible kW: 1.920  
 Working kW: 1.824  
 Capacity kW: 1.920  
 Lighting: 4320 Annual kWh  
 Heating: 617 Annual kWh  
 Cooling: 6126 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 1.341 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	20	40	20.0
Working	20	38	19.0
Capacity	20	40	20.0
Disconnected	0	0	0.0
Broken/Burned	0	2	1.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5521	597	7715	-106	13727
AVLCC \$	406	44	568	-8	1010

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0044 - ECO VII. D. & IX C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$1,899		
B. SIOH	\$104		
C. DESIGN COST	\$114		
D. TOTAL COST (1A+1B+1C)	\$2,117		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$2,117

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	11.91	\$126	11.77	\$1,479
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG			\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	16.79	\$177	11.12	\$1,970
M. DEMAND SAVINGS			\$124	11.12	\$1,379
N. TOTAL		28.7	\$427		\$4,828

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$33		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$366

**LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$366

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 4.6 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$5,194

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 2.45

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 10.4%

## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 48 - VIP GUEST HOUSE DINING**

Building 48 is a historic two story, wood frame building with a total of 8,600 square feet. The dining and kitchen facilities are located on the first floor and consist of approximately 500 square feet.

The operating hours are from 5:30 am to 11:00 am, 5 days per week.

The lighting system is primarily incandescent with chandeliers in the dining room and recessed incandescent fixtures in the kitchen.

The mechanical system consists of a wall mounted fan coil unit which is provided with chilled water by an air cooled chiller. Heating is provided by a gas fired boiler located in the basement.

Hot water is supplied by a gas fired water heater located in the basement. All dishes are washed by hand.

The following ECO's are recommended for Building 48:

1. IV. A - Night setback/setup thermostat
2. IX. A - Replace incandescent lamps with compact fluorescents

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 48

ECO NO: IX.A.

ECO NAME: Replace incandescent lamps with compact fluorescents

#### SUMMARY DATA (DEPENDENT):

KWH Savings: 709 KWH/yr

Demand Savings: 2.59 KW/yr

Gas Savings: N/A MCF/yr

Cost Savings: \$ 54.00 /yr

Implementation Cost: \$ 89.00

Simple Payback: 1.7 Years

Savings to Investment:  
Ratio (SIR): 5.41

#### ECO DESCRIPTION:

Currently, recessed incandescent fixtures are utilized in the kitchen area. This ECO replaces the incandescent lamps with 27W compact fluorescent lamps. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
1	Fan/Chandelier	None.
3	Incandescent downlight	Replace with compact fluor.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned} \text{Demand Savings} &= (.34 \text{ KW} - 1.24 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (.34 \text{ KW} - .124 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$17.28/\text{yr} \end{aligned}$$

**IMPLEMENTATION COSTS:**

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)



Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD0048A	171	874	717	53	297	10.911	-1.573	80	125	512	9	38
*BLD0048B	467	0	1590	117	0	0.000	0.000	0	268	1322	20	97

Project Description: FT SAM HOUSTON EEAP

File Name	Case Description
BLD0048A	POST RETROFIT CONDITIONS
BLD0048B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD0048A.WBR  
 Date: 10/25/1993

Lighting Annual : 171 kWh  
 Lighting Capacity : 0.124 kW  
 Annual Cooling Effect : 243 kWh  
 Annual Heating Effect : 49 kWh  
 Total Surveyed Floor Area: 504 Sqft  
 Percent Survey Completed : 50400 %  
 Lighting Power Density : 0.246 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	80	224	125	297	-8	717
AVLCC \$	6	16	9	22	-1	53

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD0048A.LLR  
 Date: 10/25/1993

Room	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Foot Candles						
-----	-----	-----	-----	-----	-----	-----
Calculated	27.3	0.5	13.9	18.93	2-kitchen	1-dinding
Measured	6.4	2.7	4.6	2.59	1-dinding	2-kitchen
Required	75.0	21.0	48.0	38.18	2-kitchen	1-dinding

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
-----	-----	-----	-----	-----	-----	-----
Calc - Req.	-20.5	-47.7	-34.1	19.25	1-dinding	2-kitchen
Meas - Req.	-14.6	-72.3	-43.4	40.78	1-dinding	2-kitchen

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Lighting System Survey Summary

One Page for Each Defined System

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD0048A.LSR  
 Date: 10/25/1993

System Number: 1      Descrip: fan/chandelier

=====

Rooms Served: 1  
 Floor Area: 336 SqFt  
 Possible kW: 0.040  
 Working kW: 0.040  
 Capacity kW: 0.040  
 Lighting: 55 Annual kWh  
 Heating: 16 Annual kWh  
 Cooling: 78 Annual kWh  
 Op Hours/Year: 1375 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time: 8.7 Months  
 Power Density: 0.119 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	72	55	96	-3	222
AVLCC \$	5	4	7	-0	16

System Number: 3      Descrip: COMPACT FLUORESCENT

=====

Rooms Served: 1  
 Floor Area: 168 SqFt  
 Possible kW: 0.084  
 Working kW: 0.084  
 Capacity kW: 0.084  
 Lighting: 116 Annual kWh  
 Heating: 33 Annual kWh  
 Cooling: 164 Annual kWh  
 Op Hours/Year: 1375 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time: 101.7 Months  
 Power Density: 0.500 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	3	3.0
Working	3	3	3.0
Capacity	3	3	3.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	151	70	201	-6	495
AVLCC \$	11	5	15	-0	36

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Room-By-Room Summary Report

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD0048A.RRR  
 Date: 10/25/1993

Room Name	Floor	#	Total Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt SYSTEM2 sqft Name	Work Watts	Pot. Watts	Watt SYSTEM3 sqft Name	Work Watts	Pot. Watts	Watt Work sqft	Watt Meas. FootC	Calc. Req. FootC
1-dinding	1	1	336	10 fan/chande	40	40	0.12	40	40	0.12	40	40	0.12	6.4	0.5
2-kitchen	1	1	168	1 COMPACT FL	84	84	0.50	84	84	0.50	84	84	0.50	2.7	27.3

Total Rooms : 2  
 Total Area Sqft : 504  
 Total People : 11  
 Total Working kW : 0.124  
 Total Potential kW : 0.124  
 Power Density W/sqft : 0.246

=====

| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD0048B.WBR

Date: 10/16/1993

Lighting Annual : 467 kWh  
 Lighting Capacity : 0.340 kW  
 Annual Cooling Effect : 657 kWh  
 Annual Heating Effect : 135 kWh  
 Total Surveyed Floor Area: 504 SqFt  
 Percent Survey Completed : 50400 %  
 Lighting Power Density : 0.675 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	613	268	732	-23	1590
AVLCC \$	0	45	20	54	-2	117

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0048\BLD00488.LSR  
Date: 10/16/1993

System Number: 1 Descrip: fan/chandelier

Rooms Served: 1  
Floor Area: 336 SqFt  
Possible kW: 0.040  
Working kW: 0.040  
Capacity kW: 0.040  
Lighting: 55 Annual kWh  
Heating: 16 Annual kWh  
Cooling: 78 Annual kWh  
Op Hours/Year: 1375 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 8.7 Months  
Power Density: 0.119 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	72	55	96	-3	220
AVLCC \$	5	4	7	-0	16

System Number: 2 Descrip: incand

Rooms Served: 1  
Floor Area: 168 SqFt  
Possible kW: 0.300  
Working kW: 0.300  
Capacity kW: 0.300  
Lighting: 413 Annual kWh  
Heating: 119 Annual kWh  
Cooling: 578 Annual kWh  
Op Hours/Year: 1375 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 6.5 Months  
Power Density: 1.786 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	3	0.0
Working	3	3	0.0
Capacity	3	3	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	541	214	636	-20	1370
AVLCC \$	40	16	47	-2	101

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BLDG 0048 - ECO IX A - REPLACE INCANDESCENT LAMPS W/COMPACT FLUOR.  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$80		
B. SIOH	\$4		
C. DESIGN COST	\$5		
D. TOTAL COST (1A+1B+1C)	\$89		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$89

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: 'NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	1.01	\$11	11.77	\$125
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG			\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	1.41	\$15	11.12	\$165
M. DEMAND SAVINGS			\$17	11.12	\$192
N. TOTAL		2.42	\$43		\$483

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$11		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$122



# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$122

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 1.7 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$605

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 6.78

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 18.2%

## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 368 - CAFETERIA**

Building 368 is a one story stucco building consisting of 5,700 square feet. This facility consists of full service kitchen and a large dining area.

The operating hours are from 6:00 am to 2:0 pm, 5 days per week.

The lighting system is primarily fluorescent with some decorative incandescent fixtures.

The mechanical system consists of 3 DX packaged rooftop units. Heating is provided by gas furnaces in the rooftop units.

Hot water is provided by a gas fired water heater. Dishwashing is accomplished using an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 368:

1. IV. A - Night setback/setup thermostat
2. VII. D - Reduce indoor/outdoor lighting to AEI levels
3. IX. A - Replace incandescent lamps with compact fluorescents
4. IX. C - Replace standard lamps with energy saving lamps
5. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING 368

ECO NO: IV.A.

ECO NAME: Night setback/setup thermostat

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>2.649</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>19.6</u>	MCF/yr
Cost Savings:	<u>\$ 164</u>	/yr
Implementation Cost:	<u>\$ 363.00</u>	
Simple Payback:	<u>2.2</u>	Years
Savings to Investment: Ratio (SIR):	<u>5.96</u>	

#### ECO DESCRIPTION:

Currently, three manual thermostats are used to control the three packaged rooftop units that serve the cafeteria and office areas. This ECO analyzes the installation of programmable night setback/setup thermostats to reduce energy consumption during unoccupied periods.

#### COST SAVINGS CALCULATIONS:

(Refer to following SimpCalc Calculations)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### MAINTENANCE COSTS:

Maintenance costs of \$5.00/year is included in the LCCA for programming, battery replacement and failures.

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

TEXAS LoanSTAR Program - ECRM Simplified Calculation Ver 2.0

11/08/93

SimpCalc 2.0 SUMMARY (by FORM) - FORT SAM HOUSTON

Page 1

Form	Facility	ECRM Desc.	Page	KWH/Yr	KW	MCF/yr	mmBtu/Yr	\$/Yr	Imp.Cost	PayBack
C7-01	BLDG 0368 CAFETERIA	Prog Thermostat	1	2694	.00	19.6	29.4	164	363	2.2
*** SUB-TOTAL ***				2694	.00	19.6	29.4	164	363	2.2
** GRAND TOTAL **				2694	.00	19.6	29.4	164	363	2.2

11/08/93

Consolidated ECRM Detail - FORT SAM HOUSTON

Page 1

C7-001 Programmable Thermostats - BLDG 0368 CAFETERIA

(G)

Cost Source:

Description:

A) .20 BTU/hr-ft-F U-Value of Walls  
 B) 2070 Sq.Ft. Wall Area (includes windows and doors)  
 C) .05 BTU/hr-ft-F U-Value of Roof  
 D) 2108 Sq.Ft. Roof Area  
 E) 70 Degree/F Heating Season Thermostat Setpoint  
 F) 55 Degree/F Heating Season Thermostat Setback Setpoint  
 G) 1950 Hours/yr Heating Season Setback Hours  
     = 13 Hrs/day x 150 Days/yr  
 H) 74 Degree/F Cooling Season Thermostat Setpoint  
 I) 90 Degree/F Cooling Season Thermostat Setback Setpoint  
 J) 2600 Hours/yr Cooling Season Setback Hours  
     = 13 Hrs/day x 200 Days/yr  
 K) .7500 Heating Equipment Efficiency (Table 2)  
 L) \$ 3.41 /MCF Cost per MCF  
 M) 8.00 BTUH/Watt EER of Air Conditioning Unit (Table 1)  
 N) \$ .0360 /KWH Cost per KWH - Summer  
 O) \$ 363 Installed Cost = 3 Thermostats x \$ 121/stat  
  
 P) 519 BTU/hf-F Total Envelope UA-Value  
 Q) 15.2 mmBTU/yr Heating Load Reduction  
 R) \$ 67 Heating Cost Reduction  
 S) 21.6 mmBTU/yr Cooling Load Reduction  
 T) \$ 97 /year Cooling Cost Reduction  
 U) \$ 164 /year Annual Cost Savings  
 V) 2.2 years Simple Payback

PROJECT NAME: FORT SAM HOUSTON EEAP	PROJECT NO: 91109912F
PROJECT LOCATION: SAN ANTONIO, TEXAS	ESTIMATOR: S.P. CLARK
SUBMITTAL: 35.0%	DATE: 25-Oct-93
ECO NO/ BUILDING: IV. A. / BLDG 0368	CHECKED BY: DJY

JOBNUMCE.WK1 55 25-Oct-93

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0368 - ECO IV. A. - NIGHT SETBACK/SETUP THERMOSTAT  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	<u>\$326</u>	
B. SIOH	<u>\$18</u>	
C. DESIGN COST	<u>\$20</u>	
D. TOTAL COST (1A+1B+1C)	<u>\$363</u>	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	<u>\$0</u>	
F. PUBLIC UTILITY COMPANY REBATE	<u>\$0</u>	
G. TOTAL INVESTMENT (1D-1E-1F)		<u>\$363</u>

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	<u>\$10.55</u>	<u>9.19</u>	<u>\$97</u>	<u>11.77</u>	<u>\$1,141</u>
B. DIST			<u>\$0</u>	<u>13.83</u>	<u>\$0</u>
C. RESID			<u>\$0</u>	<u>16.15</u>	<u>\$0</u>
D. NG	<u>\$3.31</u>	<u>20.21</u>	<u>\$67</u>	<u>15.34</u>	<u>\$1,026</u>
E. PPG			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
F. COAL			<u>\$0</u>	<u>12.82</u>	<u>\$0</u>
G. SOLAR			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
H. GEOTH			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
I. BIOMA			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
J. REFUS			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
K. WIND			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
L. OTHER			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
M. DEMAND SAVINGS			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
N. TOTAL		<u>29.4</u>	<u>\$164</u>		<u>\$2,167</u>

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	<u>(\$15)</u>
1. DISCOUNT FACTOR (TABLE A)	<u>11.1</u>
2. DISCOUNTED SAVINGS/COST (3A X 3A1)	<u>(\$167)</u>



**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** (\$167)

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 2.4 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$2,001

**6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G:** 5.50

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 16.5%

## **ENERGY CONSERVATION ANALYSIS**

### **ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 368**

ECO NO: VII. D & IX A, C, D

ECO NAME: Improve lighting efficiency.

#### **SUMMARY DATA (DEPENDENT):**

KWH Savings: 19.807 KWH/yr  
Demand Savings: 43.9 KW/yr  
Gas Savings: N/A MCF/yr  
Cost Savings: \$ 1.116 /yr  
Implementation Cost: \$ 2.244  
Simple Payback: 2.0 Years  
Savings to Investment:  
Ratio (SIR): 5.07

#### **ECO DESCRIPTION:**

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing current lighting levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
21	Decorative incandescents	Retrofit with compact fluor. lamps.
11	2-Lamp, 2' Fluor.	Retrofit with T8 lamps and elect. ballasts.
32	2-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.

#### **COST SAVINGS CALCULATIONS:**

(Refer to following Flex Output)

$$\begin{aligned} \text{KWH Demand Savings} &= [(7.41 \text{ KW} - 3.75 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (7.41 \text{ KW} - 3.75 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW}] \\ &= \$292.80/\text{yr} \end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cnts/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD0368A	8437	24037	29744	2189	8242	11.939	0.455	2013	2753	24977	203	1838
*BLD0368B	16678	0	53780	3957	0	0.000	0.000	0	4257	49523	313	3644

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD0368A	POST RETROFIT CONDITIONS
BLD0368B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD0368A.WBR  
 Date: 10/17/1993

Lighting Annual : 8437 kWh  
 Lighting Capacity : 3.750 kW  
 Annual Cooling Effect : 11802 kWh  
 Annual Heating Effect : 1205 kWh  
 Total Surveyed Floor Area: 2248 SqFt  
 Percent Survey Completed : 224800 %  
 Lighting Power Density : 1.668 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
	-----	-----	-----	-----	-----	-----
PVLCC \$	2013	10782	2753	14402	-207	29744
AVLCC \$	148	793	203	1060	-15	2189

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD0368A.LLR  
 Date: 10/17/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	77.6	11.6	35.2	24.96	7-stor	4-office
Measured	50.3	0.0	30.2	20.37	2-dining	7-stor
Required	50.0	5.0	24.3	15.92	5-kitchen	2-dining
Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	72.6	-18.4	10.9	29.66	7-stor	4-office
Meas - Req.	45.3	-16.1	6.0	21.13	2-dining	3-toil

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Lighting System Survey Summary

One Page for Each Defined System

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD0368A.LSR  
 Date: 10/17/1993

System Number: 1      Descrip: decor, pendant, incand

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Rooms Served: 2  
 Floor Area: 1070 SqFt  
 Possible kW: 0.693  
 Working kW: 0.693  
 Capacity kW: 0.693  
 Lighting: 1559 Annual kWh  
 Heating: 223 Annual kWh  
 Cooling: 2211 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 71.0 Months  
 Power Density: 0.648 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	21	42	42.0
Working	21	42	42.0
Capacity	21	42	42.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1993	1790	2785	-38	6712
AVLCC \$	147	132	205	-3	494

System Number: 2      Descrip: 2x2 lay-in

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Rooms Served: 4  
 Floor Area: 1736 SqFt  
 Possible kW: 0.775  
 Working kW: 0.775  
 Capacity kW: 0.775  
 Lighting: 1745 Annual kWh  
 Heating: 249 Annual kWh  
 Cooling: 2432 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 85.2 Months  
 Power Density: 0.447 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	11	22	11.0
Working	11	22	11.0
Capacity	11	22	11.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2230	261	2941	-43	5847
AVLCC \$	164	19	216	-3	430

System Number: 3      Descrip: 2x4 lay-in

Rooms Served: 2  
 Floor Area: 370 SqFt  
 Possible kW: 1.355  
 Working kW: 1.355  
 Capacity kW: 1.355  
 Lighting: 3048 Annual kWh  
 Heating: 435 Annual kWh  
 Cooling: 4248 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 3.661 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	19	38	19.0
Working	19	38	19.0
Capacity	19	38	19.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3895	437	5138	-75	10175
AVLCC \$	287	32	378	-5	749

System Number: 4      Descrip: 2x4 lay-in

Rooms Served: 2  
 Floor Area: 870 SqFt  
 Possible kW: 0.816  
 Working kW: 0.816  
 Capacity kW: 0.816  
 Lighting: 1837 Annual kWh  
 Heating: 262 Annual kWh  
 Cooling: 2560 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 0.938 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	13	26	13.0
Working	13	26	13.0
Capacity	13	26	13.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2348	231	3096	-45	6162
AVLCC \$	173	17	228	-3	453



System Number: 5      Descrip: 8' strip

=====

Rooms Served: 1  
Floor Area: 32 SqFt  
Possible kW: 0.110  
Working kW: 0.110  
Capacity kW: 0.110  
Lighting: 248 Annual kWh  
Heating: 35 Annual kWh  
Cooling: 351 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 85.2 Months  
Power Density: 3.438 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	2	1.0
Working	1	2	1.0
Capacity	1	2	1.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	316	34	442	-6	846
AVLCC \$	23	3	33	-0	62

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Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD0368A.RRR  
 Date: 10/17/1993

Room Name	Floor	#	Total Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt SYSTEM2 Name	Work Watts	Pot. Watts	Watt SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Pot. Watts	Watt sqft	Calc. FootC	Req. FootC
1-serving	1	1	310	15	528	528	0.69	282	282	2x4 lay-in	165	165	0.53	1377	4.44	29.2	20.0
2-dining	1	1	760	120 decor, pen	282	282	2x2 lay-in	282	282	2x4 lay-in	282	282	0.37	810	1.07	50.3	5.0
3-toil	1	2	216	3 2x2 lay-in	282	282	1.31	282	282	2x4 lay-in	282	282	0.37	282	1.31	13.9	30.0
4-office	1	1	60	1 2x4 lay-in	143	143	2.38	143	143	2x4 lay-in	143	143	0.28	143	2.38	49.3	30.0
5-kitchen	1	1	760	4 2x4 lay-in	691	691	0.91	212	212	2x2 lay-in	212	212	0.28	902	1.19	50.3	50.0
6-office	1	1	110	1 2x4 lay-in	126	126	1.14	126	126	2x2 lay-in	126	126	0.28	126	1.14	18.7	30.0
7-stor	1	1	32	0 8' strip	110	110	3.44	110	110	2x4 lay-in	110	110	0.28	110	3.44	0.0	5.0

Total Rooms : 8  
 Total Area Sqft : 2248  
 Total People : 147  
 Total Working kW : 3.750  
 Total Potential kW : 3.750  
 Power Density W/sqft : 1.668

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD0368B.WBR  
 Date: 10/16/1993

Lighting Annual : 16678 kWh  
 Lighting Capacity : 7.412 kW  
 Annual Cooling Effect : 23367 kWh  
 Annual Heating Effect : 2383 kWh  
 Total Surveyed Floor Area: 2248 SqFt  
 Percent Survey Completed : 224800 %  
 Lighting Power Density : 3.297 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	21314	4257	28618	-409	53780
AVLCC \$	0	1568	313	2106	-30	3957

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0368\BLD03688.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 2x4 lay-in, acrylic lens

Rooms Served: 1  
Floor Area: 310 Sqft  
Possible kW: 2.385  
Working kW: 2.305  
Capacity kW: 2.385  
Lighting: 5366 Annual kWh  
Heating: 767 Annual kWh  
Cooling: 7479 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 142.1 Months  
Power Density: 7.437 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	15	60	15.0
Working	15	58	14.0
Capacity	15	60	15.0
Disconnected	0	0	0.0
Broken/Burned	0	2	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	6858	771	9045	-132	16543
AVLCC \$	505	57	666	-10	1217

System Number: 2      Descrip: decor, pendant, incand

Rooms Served: 2  
Floor Area: 1070 Sqft  
Possible kW: 2.100  
Working kW: 1.900  
Capacity kW: 2.100  
Lighting: 4725 Annual kWh  
Heating: 675 Annual kWh  
Cooling: 6700 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 4.0 Months  
Power Density: 1.776 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	21	21	0.0
Working	21	19	0.0
Capacity	21	21	0.0
Disconnected	0	0	0.0
Broken/Burned	0	2	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	6038	2447	8439	-116	16808
AVLCC \$	444	180	621	-9	1237

System Number: 3      Descrip: 2x2 lay-in

Rooms Served: 4  
 Floor Area: 1736 SqFt  
 Possible kW: 1.062  
 Working kW: 1.062  
 Capacity kW: 1.062  
 Lighting: 2388 Annual kWh  
 Heating: 341 Annual kWh  
 Cooling: 3329 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 85.2 Months  
 Power Density: 0.611 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	11	22	11.0
Working	11	22	11.0
Capacity	11	22	11.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3052	501	4026	-59	7520
AVLCC \$	225	37	296	-4	553

System Number: 4      Descrip: 2x4 lay-in

Rooms Served: 2  
 Floor Area: 370 SqFt  
 Possible kW: 0.480  
 Working kW: 0.288  
 Capacity kW: 0.480  
 Lighting: 1080 Annual kWh  
 Heating: 154 Annual kWh  
 Cooling: 1505 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 0.778 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	5	10	2.0
Working	4	6	0.0
Capacity	5	10	2.0
Disconnected	0	0	0.0
Broken/Burned	1	2	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1380	108	1820	-26	3282
AVLCC \$	102	8	134	-2	242

System Number: 7      Descrip: 2x4 lay-in

Rooms Served: 2  
 Floor Area: 870 SqFt  
 Possible kW: 1.248  
 Working kW: 1.104  
 Capacity kW: 1.248  
 Lighting: 2808 Annual kWh  
 Heating: 401 Annual kWh  
 Cooling: 3913 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 1.269 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	13	26	13.0
Working	13	23	11.0
Capacity	13	26	13.0
Disconnected	0	0	0.0
Broken/Burned	0	3	1.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3589	388	4733	-69	8641
AVLCC \$	264	29	348	-5	636

System Number: 8      Descrip: 8' strip

Rooms Served: 1  
 Floor Area: 32 SqFt  
 Possible kW: 0.138  
 Working kW: 0.138  
 Capacity kW: 0.138  
 Lighting: 310 Annual kWh  
 Heating: 44 Annual kWh  
 Cooling: 440 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 85.2 Months  
 Power Density: 4.313 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	2	1.0
Working	1	2	1.0
Capacity	1	2	1.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	397	42	555	-8	986
AVLCC \$	29	3	41	-1	73

# LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0368 - ECO VII. D. & IX C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

## 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$2,013		
B. SIOH	\$111		
C. DESIGN COST	\$121		
D. TOTAL COST (1A+1B+1C)	\$2,244		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$2,244

## 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: 'NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	28.13	\$297	11.77	\$3,493
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG			\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	39.47	\$416	11.12	\$4,630
M. DEMAND SAVINGS			\$293	11.12	\$3,256
N. TOTAL		67.6	\$1,006		\$11,379

## 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$110		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$1,221

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$1,221

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 2.0 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$12,600

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 5.61

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 16.7%



## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 407 - OFFICERS CLUB DINING**

Building 407 is a two story stucco building consisting of 41,000 square feet. This facility contains a full service kitchen and a large dining area which consists of 7,800 square feet.

The operating hours are from 6:00 am to 10:00 pm Wednesday thru Saturday and 6:00 am to 3:00 pm Sunday thru Tuesday.

The lighting system is a combination of incandescent and fluorescent fixtures. The dining areas use incandescent downlights and chandeliers. The kitchen uses fluorescent fixtures.

The mechanical system consists of a rooftop multizone air handling unit for the main dining and kitchen areas served by an air cooled chiller. The auxiliary dining rooms and the remainder of the building are served by Direct Expansion (DX) fan coil units with water cooled reciprocating compressors.

Hot water is provided to the kitchen via a steam to hot water converter located in the basement. Steam is provided by a gas fire boiler. Dishwashing is accomplished using an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 407:

1. IV. C. 1) - Add stop//start function to HVAC equipment
2. VII. C - Remove unneeded lamps or fixtures
3. VII. D - Remove unneeded indoor/outdoor lighting to AEI levels
4. IX. A - Replace incandescent lamps with compact fluorescents
5. IX. B - Replace incandescent exit fixtures with LED
6. IX. C - Replace standard lamps with energy savings lamps
3. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's)- BUILDING NO. 407

ECO NO: IV.C.1

ECO NAME: Add stop/start function for HVAC systems.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>181.265</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>660.6</u>	MCF/yr
Cost Savings:	<u>\$ 8.761</u>	/yr
Implementation Cost:	<u>\$ 2.233</u>	
Simple Payback:	<u>.3</u>	Years
Savings to Investment: Ratio (SIR):	<u>49.88</u>	

#### ECO DESCRIPTION:

Presently, the mechanical systems are not controlled by the existing basewide EMCS system. This ECO analyzes the addition of time clocks and relays to shut-down the HVAC systems during unoccupied hours.

#### COST SAVINGS CALCULATIONS:

(Refer to following Trace Output)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### MAINTENANCE COSTS:

Maintenance costs of \$15/year for each timeclock included in the LCCA for adjustments and failures.

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

LINE #	
1	JOB - 1
2	01/FORT SAM HOUSTON EEAP
3	01/SAN ANTONIO, TEXAS
	01/FWD-COE
5	01/SCOTT CLARK
6	01/
7	08/SANANTON
8	09/JAN/DEC
9	10/CLTD-CLF
10	11/JAN/DEC
11	LOAD - 1
12	19/1/ENERGY CONSERVATION SIMULATION
13	20/1/1/SW WING, 1ST FL/98/32//4//14
14	20/2/2/SE WING, 1ST FL/98/32//4//14
15	20/3/3/OLD BALLROOM/144/50//4//14
16	20/4/4/NEW DINING/84/48//4//16
17	20/5/5/KITCHEN/90/54//4//16
18	20/6/6/SW WING, 2ND FL/98/32//4//14
19	20/7/7/SE WING, 2ND FL/98/30//4//14
20	20/8/8/ABOVE BALLROOM/144/50//4//14
21	21/M/78/50/85//70/60
22	22/4/1/YES///.07
23	22/5/1/YES///.07
24	22/6/1/YES///.07
25	22/7/1/YES///.07
26	22/8/1/YES///.07
27	24/1/1/98/14/.15//90
28	24/1/2/32/14/.15//180
29	24/1/3/98/14/.15//270
30	24/2/1/98/14/.15//90
31	24/2/2/30/14/.15//180
	24/2/3/98/14/.15//270
	24/3/1/82/14/.15//180
34	24/3/2/50/14/.15//90
35	24/3/3/50/14/.15//270
36	24/4/1/48/14/.15//90
37	24/4/2/84/14/.15//0
38	24/5/1/42/14/.15//90
39	24/5/2/54/14/.15//0
40	24/5/3/90/14/.15//270
41	25/1/1///50/1.07/.95
42	25/1/2///50/1.07/.95
43	25/1/3///50/1.07/.95
44	25/2/1///50/1.07/.95
45	25/2/2///50/1.07/.95
46	25/2/3///50/1.07/.95
47	25/3/1///50/1.07/.95
48	25/3/2///50/1.07/.95
49	25/3/3///50/1.07/.95
50	25/4/1///50/1.07/.95
51	25/4/2///50/1.07/.95
52	25/4/3///50/1.07/.95
53	25/6/1///50/1.07/.95
54	25/6/2///50/1.07/.95
55	25/6/3///50/1.07/.95
56	25/7/1///50/1.07/.95
57	25/7/2///50/1.07/.95
58	25/7/3///50/1.07/.95

CONTENTS OF : H:\JOB\911099\12F\TRACE\EQUIPECO\0407.TM

LINE #	
59	25/8/1///50/1.07/.95
60	25/8/2///50/1.07/.95
61	25/8/3///50/1.07/.95
62	26/M/0407PLP/0407LT
63	27/1/150/SF-PERS/255/255/2.5/WATT-SF///30
64	27/2/150/SF-PERS/255/255/2.5/WATT-SF///30
65	27/3/75/SF-PERS/255/255/2.5/WATT-SF///30
66	27/4/75/SF-PERS/255/255/2.5/WATT-SF///30
67	27/5/100/SF-PERS/255/255/2.5/WATT-SF///30
68	27/6/150/SF-PERS/255/255/2.5/WATT-SF///30
69	27/7/150/SF-PERS/255/255/2.5/WATT-SF///30
70	27/8/150/SF-PERS/255/255/2.5/WATT-SF///30
71	28/M/1/MISC/.5/WATT-SF/0407LT
72	28/5/1/MISC/4.0/WATT-SF
73	29/M/15/CFM-P/15/CFM-P
74	30/M/1/CFM-SF/1/CFM-SF
75	SYSTEM - 1
76	39/1/EXISTING CONDITIONS
77	40/1/VTCV
78	41/1/1/3/6/8
79	42/1/2.5/2.5
80	40/2/RTMZ
81	41/2/4/5
82	42/2/2.5/2.5
83	EQUIPMENT - 1
84	60/1/1/PKPLANT/1/1
85	60/2/2/PKPLANT/2/2
86	61/1/1
87	61/2/2
88	62/1/EQ1131L/1/100/TONS/1.01/KW-TON
	62/2/EQ1100S/1/37/TONS/1.34/KW-TON
	63/1///5/HP
91	63/2/3/HP
92	65/1/1/1/2
93	66/1/1
94	67/1/EQ2002/1/5/HP
95	SYSTEM - 2
96	39/2/EXISTING CONDITIONS WITH STOP-START
97	40/1/VTCV
98	41/1/1/3/6/8
99	42/1/2.5/2.5
100	45/1/0407EX
101	46/1///START2/STOP2
102	40/2/RTMZ
103	41/2/4/5
104	42/2/2.5/2.5
105	45/2/0407EX
106	46/2///START2/STOP2
107	EQUIPMENT - 2
108	60/1/1/PKPLANT/1/1
109	60/2/2/PKPLANT/2/2
110	61/1/1
111	61/2/2
112	62/1/EQ1131L/1/100/TONS/1.01/KW-TON
113	62/2/EQ1100S/1/37/TONS/1.34/KW-TON
114	63/1///5/HP
115	63/2/3/HP
116	65/1/1/1/2

CONTENTS OF : H:\JOB\911099\12F\TRACE\EQUIPECO\0407.TM

LINE # -----

117 66/1/1

118 67/1/EQ2002/1/5/HP

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TRACE 600 ANALYSIS  
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by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO, TEXAS  
FWD-COE  
SCOTT CLARK

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 12:18:40 10/23/93  
Dataset Name: 0407 .TM

AIRFLOW - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	3,395	51,352	51,352	51,352	3,395	0	0
2	RTMZ	1,535	12,573	12,579	12,579	1,535	0	0
Totals		4,930	63,925	63,931	63,931	4,930	0	0

CAPACITY - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

System Number	System Type	Cooling					Heating					
		Main Sys. Capacity (Tons)	Aux. Sys. Capacity (Tons)	Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Main Sys. Capacity (Btuh)	Aux. Sys. Capacity (Btuh)	Preheat Capacity (Btuh)	Reheat Capacity (Btuh)	Humidif. Capacity (Btuh)	Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	VTCV	84.7	0.0	0.0	84.7	-415,906	0	0	0	0	0	-415,906
2	RTMZ	30.4	0.0	0.0	30.4	-237,040	0	0	0	0	0	-237,040
Totals		115.2	0.0	0.0	115.2	-652,945	0	0	0	0	0	-652,945

The building peaked at hour 17 month 8 with a capacity of 109.8 tons

ENGINEERING CHECKS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	6.61	1.92	605.9	315.6	38.02	1.92	-15.55	26,748
2	Main	RTMZ	12.21	1.41	413.5	292.4	41.04	1.41	-26.66	8,892



System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****			HEATING COIL PEAK *****		
Peak at Time ==>						Mo/Hr: 8/17			Mo/Hr: 13/ 1		
Outside Air ==>						OADB: 94			OADB: 30		
Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct		Space Peak	Coil Peak	Perct
Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads											
Skylite Solr	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	48,109	48,109	4.73	*	0	0.00	*	0	-36,427	8.76
Glass Solar	308,420	0	308,420	30.33	*	339,304	51.39	*	0	0	0.00
Glass Cond	71,862	0	71,862	7.07	*	61,511	9.32	*	-209,124	-209,124	50.28
Wall Cond	12,614	16,082	28,696	2.82	*	13,078	1.98	*	-11,448	-26,406	6.35
Partition	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Sub Total==>	392,896	64,191	457,087	44.94	*	413,893	62.69	*	-220,572	-271,957	65.39
Internal Loads											
Lights	137,250	58,821	196,071	19.28	*	145,568	22.05	*	0	0	0.00
People	83,927		83,927	8.25	*	38,403	5.82	*	0	0	0.00
Misc	41,616	0	41,616	4.09	*	43,417	6.58	*	0	0	0.00
Sub Total==>	262,793	58,821	321,614	31.62	*	227,388	34.44	*	0	0	0.00
Ceiling Load	16,375	-16,375	0	0.00	*	18,928	2.87	*	-6,802	0	0.00
Outside Air	0	0	154,095	15.15	*	0	0.00	*	0	-146,896	35.32
Sup. Fan Heat			91,292	8.98	*		0.00	*		0	0.00
Ret. Fan Heat		0	0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0	0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	0		0	0.00	*	0	0.00	*	0	0	0.00
Heat		-7,095	-7,095	-0.70	*		0.00	*		2,947	-0.71
Minimal Bypass		0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	672,064	99,542	1,016,993	100.00	*	660,210	100.00	*	-227,374	-415,906	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Gross (sf)	(%)	
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor	Part	ExFlr
Main Clg	84.7	1,017.0	880.0	51,352	80.9	67.3	81.6	64.5	61.3	78.8	0	0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Totals	84.7	1,017.0								13,276	0	0
										8,904	4,452	50

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA	Clg % OA	Clg Cfm/Sqft	Clg Cfm/Ton	Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F										
Main Htg	-415.9	51,352	66.6	Vent	3,395	3,395			1.92	605.93	SADB	66.1	74.1
Aux Htg	0.0	0	0.0	Infil	0	0					Plenum	79.9	69.2
Preheat	-0.0	51,352	66.6	Supply	51,352	51,352			315.61		Return	79.9	69.2
Reheat	0.0	0	0.0	Mincfm	0	0			38.02		Ret/OA	80.9	66.6
Humidif	0.0	0	0.0	Return	51,352	51,352			No. People	226	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	Exhaust	3,395	3,395			Htg % OA	6.6	Fn MtrTD	0.4	0.4
Total	-415.9			Rm Exh	0	0			Htg Cfm/Sqft	1.92	Fn BldTD	0.3	0.3
				Auxil	0	0			Htg Btuh/SqFt	-15.55	Fn Frict	0.9	0.9

System 2 Peak RTMZ - ROOFTOP MULTIZONE

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****			HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/14						Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 96/ 79/126.0						OADB: 93			OADB: 30		
	Space	Ret. Air	Ret. Air	Net	Percnt		Space	Percnt	Space Peak	Coil Peak	Percnt
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot	Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Envelope Loads											
Skylite Solr	0	0		0	0.00		0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00		0	0.00	0	0	0.00
Roof Cond	0	31,319		31,319	8.58		0	0.00	0	-23,756	12.22
Glass Solar	37,884	0		37,884	10.38		41,580	19.13	0	0	0.00
Glass Cond	14,534	0		14,534	3.98		15,226	7.01	-43,403	-43,403	22.32
Wall Cond	10,568	4,348		14,916	4.09		16,565	7.62	-14,490	-20,862	10.73
Partition	0			0	0.00		0	0.00	0	0	0.00
Exposed Floor	0			0	0.00		0	0.00	0	0	0.00
Infiltration	0			0	0.00		0	0.00	0	0	0.00
Sub Total==>	62,985	35,667		98,652	27.04		73,371	33.76	-57,893	-88,021	45.27
Internal Loads											
Lights	44,322	18,995		63,317	17.35		46,354	21.33	0	0	0.00
People	37,600			37,600	10.30		17,338	7.98	0	0	0.00
Misc	65,174	0	0	65,174	17.86		69,155	31.82	0	0	0.00
Sub Total==>	147,096	18,995	0	166,091	45.52		132,847	61.13	0	0	0.00
Ceiling Load	9,380	-9,380		0	0.00		11,106	5.11	-5,170	0	0.00
Outside Air	0	0	0	83,332	22.84		0	0.00	0	-66,438	34.17
Sup. Fan Heat				22,352	6.13			0.00		0	0.00
Ret. Fan Heat		0		0	0.00			0.00		0	0.00
Duct Heat Pkup		0		0	0.00			0.00		0	0.00
OV/UNDR Sizing	0			0	0.00		0	0.00	-43,043	-43,043	22.14
Reheat		-5,530	0	-5,530	-1.52			0.00		3,047	-1.57
Terminal Bypass		0	0	0	0.00			0.00		0	0.00
Grand Total==>	219,461	39,752	0	364,897	100.00		217,324	100.00	-106,106	-194,455	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity		Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	30.4	364.9	289.9	12,573	83.1	67.7	80.4	60.4	58.8	74.0	8,892	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Totals	30.4	364.9								Roof	8,892	0 0
										Wall	4,452	924 21

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating		Clg % OA	12.2	Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F	Vent	1,535	1,535		Clg Cfm/Sqft	1.41	SADB	62.0	77.8
Main Htg	-237.0	12,579	60.4	77.8	Infil	0	0	Clg Cfm/Ton	413.47	Plenum	81.3	68.2
Aux Htg	0.0	0	0.0	0.0	Supply	12,573	12,579	Clg Sqft/Ton	292.42	Return	81.3	68.2
Preheat	-0.0	12,573	63.5	60.4	Mincfm	0	0	Clg Btuh/Sqft	41.04	Ret/OA	83.1	63.5
Reheat	0.0	0	0.0	0.0	Return	12,573	12,579	No. People	102	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	1,535	1,535	Htg % OA	12.2	Fn MtrTD	0.4	0.4
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	1.41	Fn BldTD	0.3	0.3
Total	-237.0			Auxil	0	0		Htg Btuh/Sqft	-26.66	Fn Frict	0.9	0.9

MAIN SYSTEM COOLING - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

PEAK COOLING LOADS  
(Main System)

		Space							Coil						
Room		Peak	OA	Rm	Supp.	Space	Space	Space	Peak	OA	Rm	Supp.	Coil	Coil	Coil
Number	Description	Time	Cond.	Dry	Dry	Air	Sens.	Lat.	Time	Cond.	Dry	Dry	Air	Sens.	Lat.
		Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load	Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load
			(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)		(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)
1	SW WING, 1ST FL	8/17	94 74	78	66.0	13,769	178,242	4,265	8/17	94 74	78	66.1	13,769	218,709	9,375
Zone	1 Total/Ave.		94 74	78	66.0	13,769	178,242	4,265		94 74	78	66.1	13,769	218,709	9,375
Zone	1 Block	8/17	94 74	78	66.0	13,769	178,242	4,265	8/17	94 74	78	66.1	13,769	218,709	9,375
2	SE WING, 1ST FL	7/18	93 71	78	66.0	13,722	177,685	4,265	8/17	94 74	78	66.1	13,722	217,277	9,375
Zone	2 Total/Ave.		93 71	78	66.0	13,722	177,685	4,265		94 74	78	66.1	13,722	217,277	9,375
Zone	2 Block	7/18	93 71	78	66.0	13,722	177,685	4,265	8/17	94 74	78	66.1	13,722	217,277	9,375
3	OLD BALLROOM	9/17	87 73	78	61.8	10,584	185,860	19,584	8/14	96 79	78	63.9	10,584	219,778	70,478
Zone	3 Total/Ave.		87 73	78	61.8	10,584	185,860	19,584		96 79	78	63.9	10,584	219,778	70,478
Zone	3 Block	9/17	87 73	78	61.8	10,584	185,860	19,584	8/14	96 79	78	63.9	10,584	219,778	70,478
6	SW WING, 2ND FL	7/18	93 71	78	69.8	3,136	27,974	4,265	8/14	96 79	78	70.4	3,136	52,979	11,272
Zone	6 Total/Ave.		93 71	78	69.8	3,136	27,974	4,265		96 79	78	70.4	3,136	52,979	11,272
Zone	6 Block	7/18	93 71	78	69.8	3,136	27,974	4,265	8/14	96 79	78	70.4	3,136	52,979	11,272
7	SE WING, 2ND FL	7/18	93 71	78	69.8	2,940	26,225	3,998	8/14	96 79	78	70.4	2,940	49,668	10,567
Zone	7 Total/Ave.		93 71	78	69.8	2,940	26,225	3,998		96 79	78	70.4	2,940	49,668	10,567
Zone	7 Block	7/18	93 71	78	69.8	2,940	26,225	3,998	8/14	96 79	78	70.4	2,940	49,668	10,567
8	ABOVE BALLROOM	7/18	93 71	78	69.8	7,200	64,224	9,792	8/14	96 79	78	70.4	7,200	121,635	25,879
Zone	8 Total/Ave.		93 71	78	69.8	7,200	64,224	9,792		96 79	78	70.4	7,200	121,635	25,879
Zone	8 Block	7/18	93 71	78	69.8	7,200	64,224	9,792	8/14	96 79	78	70.4	7,200	121,635	25,879
tem	1 Total/Ave.		94 74	78	66.1	51,352	660,210	46,169		96 79	78	66.7	51,352	880,046	136,947
tem	1 Block	8/17	94 74	78	69.8	51,352	649,877	46,169	8/14	96 79	78	69.8	51,352	803,775	148,893
4	NEW DINING	7/14	96 77	78	62.0	5,746	99,316	10,967	8/14	96 79	78	62.9	5,746	137,057	39,468
Zone	4 Total/Ave.		96 77	78	62.0	5,746	99,316	10,967		96 79	78	62.9	5,746	137,057	39,468
Zone	4 Block	7/14	96 77	78	62.0	5,746	99,316	10,967	8/14	96 79	78	62.9	5,746	137,057	39,468
5	KITCHEN	7/18	93 71	78	62.0	6,827	118,008	9,790	8/14	96 79	78	63.8	6,827	152,817	35,556
Zone	5 Total/Ave.		93 71	78	62.0	6,827	118,008	9,790		96 79	78	63.8	6,827	152,817	35,556
Zone	5 Block	7/18	93 71	78	62.0	6,827	118,008	9,790	8/14	96 79	78	63.8	6,827	152,817	35,556
System	2 Total/Ave.		93 71	78	62.0	12,573	217,324	20,758		96 79	78	63.4	12,573	289,874	75,023
System	2 Block	7/18	93 71	78	62.5	12,573	211,002	20,758	8/14	96 79	78	63.4	12,573	289,874	75,023

MAIN SYSTEM HEATING - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- P E A K   H E A T I N G   L O A D S -----  
(Main System)

Room Number	Description	Floor Area (Sq Ft)	----- Space -----					----- Coil -----					Coil Air Flow (Cfm)	Coil Sens. Load (Btuh)
			Peak Time Mo/Hr	OA Cond. DB/WB (F)	Rm Dry Blb (F)	Supp. Dry Bulb (F)	Space Air Flow (Cfm)	Space Sens. Load (Btuh)	Peak Time Mo/Hr	OA Cond. DB/WB (F)	Rm Dry Blb (F)	Supp. Dry Bulb (F)		
1	SW WING, 1ST FL	3,136	13/ 1	30 26	70	75.4	13,769	-79,870	13/ 1	30 26	70	75.4	13,769	-105,122
Zone	1 Total/Ave.	3,136		30 26	70	75.4	13,769	-79,870		30 26	70	75.4	13,769	-105,122
Zone	1 Block	3,136	13/ 1	30 26	70	75.4	13,769	-79,870	13/ 1	30 26	70	75.4	13,769	-105,122
2	SE WING, 1ST FL	3,136	13/ 1	30 26	70	75.3	13,722	-79,177	13/ 1	30 26	70	75.3	13,722	-104,388
Zone	2 Total/Ave.	3,136		30 26	70	75.3	13,722	-79,177		30 26	70	75.3	13,722	-104,388
Zone	2 Block	3,136	13/ 1	30 26	70	75.3	13,722	-79,177	13/ 1	30 26	70	75.3	13,722	-104,388
3	OLD BALLROOM	7,200	13/ 1	30 26	70	75.7	10,584	-64,951	13/ 1	30 26	70	75.7	10,584	-135,200
Zone	3 Total/Ave.	7,200		30 26	70	75.7	10,584	-64,951		30 26	70	75.7	10,584	-135,200
Zone	3 Block	7,200	13/ 1	30 26	70	75.7	10,584	-64,951	13/ 1	30 26	70	75.7	10,584	-135,200
6	SW WING, 2ND FL	3,136	13/ 1	30 26	70	70.2	3,136	-798	13/ 1	30 26	70	70.2	3,136	-16,818
Zone	6 Total/Ave.	3,136		30 26	70	70.2	3,136	-798		30 26	70	70.2	3,136	-16,818
Zone	6 Block	3,136	13/ 1	30 26	70	70.2	3,136	-798	13/ 1	30 26	70	70.2	3,136	-16,818
7	SE WING, 2ND FL	2,940	13/ 1	30 26	70	70.2	2,940	-748	13/ 1	30 26	70	70.2	2,940	-15,767
Zone	7 Total/Ave.	2,940		30 26	70	70.2	2,940	-748		30 26	70	70.2	2,940	-15,767
Zone	7 Block	2,940	13/ 1	30 26	70	70.2	2,940	-748	13/ 1	30 26	70	70.2	2,940	-15,767
8	ABOVE BALLROOM	7,200	13/ 1	30 26	70	70.2	7,200	-1,831	13/ 1	30 26	70	70.2	7,200	-38,612
Zone	8 Total/Ave.	7,200		30 26	70	70.2	7,200	-1,831		30 26	70	70.2	7,200	-38,612
Zone	8 Block	7,200	13/ 1	30 26	70	70.2	7,200	-1,831	13/ 1	30 26	70	70.2	7,200	-38,612
System	1 Total/Ave.	26,748		30 26	70	74.1	51,352	-227,374		30 26	70	74.1	51,352	-415,906
System	1 Block	26,748	13/ 1	30 26	70	74.1	51,352	-227,374	13/ 1	30 26	70	74.1	51,352	-415,906
4	NEW DINING	4,032	13/ 1	30 26	70	77.8	5,752	-48,519	13/ 1	30 26	70	77.8	5,752	-108,392
Zone	4 Total/Ave.	4,032		30 26	70	77.8	5,752	-48,519		30 26	70	77.8	5,752	-108,392
Zone	4 Block	4,032	13/ 1	30 26	70	77.8	5,752	-48,519	13/ 1	30 26	70	77.8	5,752	-108,392
5	KITCHEN	4,860	13/ 1	30 26	70	77.8	6,827	-57,587	13/ 1	30 26	70	77.8	6,827	-128,648
Zone	5 Total/Ave.	4,860		30 26	70	77.8	6,827	-57,587		30 26	70	77.8	6,827	-128,648
Zone	5 Block	4,860	13/ 1	30 26	70	77.8	6,827	-57,587	13/ 1	30 26	70	77.8	6,827	-128,648
System	2 Total/Ave.	8,892		30 26	70	77.8	12,579	-106,106		30 26	70	77.8	12,579	-237,040
System	2 Block	8,892	13/ 1	30 26	70	77.8	12,579	-106,106	13/ 1	30 26	70	77.8	12,579	-237,040

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

January			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	QADB	QAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	41.3	36.7	-108,436	6.6	-180,557	12.5	-176,995	11.9	-152,194	9.2	-157,590	9.6
2	40.0	36.0	-107,511	6.3	-178,257	11.8	-175,691	11.0	-148,885	8.5	-152,050	9.1
3	39.5	35.9	-105,415	5.9	-176,703	11.2	-171,526	10.3	-143,436	7.9	-151,788	8.7
4	39.9	36.4	-102,337	5.5	-169,377	10.6	-163,153	9.7	-136,315	7.4	-145,235	8.4
5	40.8	37.6	-98,539	5.1	-166,649	10.2	-160,074	9.2	-131,283	7.0	-144,358	8.1
6	42.4	39.4	-94,291	4.8	-156,622	9.9	-151,615	8.9	-123,573	6.8	-138,432	7.9
7	44.4	41.5	-523,176	5.4	-348,072	10.1	-437,162	9.2	-380,688	7.4	-326,425	8.6
8	46.9	44.1	-329,112	6.4	-198,152	10.4	-246,063	9.7	-244,981	8.3	-223,261	9.5
9	49.5	46.6	-138,962	8.2	-141,857	11.6	-139,521	11.0	-147,785	9.9	-138,617	10.9
10	52.2	48.2	-143,204	10.2	-136,247	12.8	-142,047	12.3	-139,159	11.4	-141,606	12.3
11	54.9	49.2	-141,634	16.4	-115,612	14.1	-133,928	13.7	-141,485	13.0	-128,143	15.5
12	57.3	50.1	-139,860	29.1	-107,233	26.1	-109,978	17.8	-134,274	17.4	-107,504	25.9
13	59.4	50.4	-132,507	41.2	-98,257	34.9	-100,571	30.9	-100,762	32.6	-98,454	34.7
14	60.9	50.0	-88,055	47.4	-92,527	46.0	-94,500	45.1	-94,671	45.0	-92,688	45.9
15	61.9	50.3	-85,061	51.7	-89,750	49.1	-126,278	40.1	-126,409	40.0	-89,875	49.0
16	62.2	49.8	-82,134	64.1	-86,476	52.2	-132,402	16.5	-132,402	16.4	-86,573	52.1
17	61.8	49.3	-78,702	68.1	-82,097	54.1	-133,157	16.1	-133,157	16.1	-82,171	54.0
18	60.4	48.6	-80,089	61.1	-82,139	51.5	-134,024	18.7	-134,024	18.7	-82,197	51.5
19	58.3	48.2	-107,846	47.0	-107,413	40.3	-139,595	16.9	-139,595	16.9	-107,458	40.3
20	55.6	46.8	-116,946	39.1	-114,789	34.7	-146,756	13.7	-146,756	13.6	-114,824	34.7
21	52.5	44.9	-126,166	31.5	-124,221	28.6	-153,364	12.7	-153,061	12.7	-124,248	28.6
22	49.3	42.5	-132,372	26.2	-131,022	23.9	-155,830	11.8	-155,543	11.8	-131,043	23.8
23	46.2	40.4	-171,688	14.2	-171,688	13.9	-157,412	10.9	-157,140	10.8	-171,688	13.9
24	43.5	38.5	-175,402	13.5	-177,960	13.1	-157,262	10.0	-156,974	10.0	-177,825	13.1

Hour	----- Design -----				----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
	OADB	QAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	45.2	40.8	-178,479	12.6	-174,341	13.2	-171,994	12.5	-154,054	10.0	-157,289	10.3
2	43.4	39.0	-172,596	12.0	-175,633	12.4	-169,899	11.6	-149,257	9.3	-154,405	9.8
3	41.9	37.4	-169,860	11.4	-173,655	11.7	-167,086	10.7	-145,848	8.6	-152,108	9.3
4	40.8	36.7	-166,461	10.7	-170,782	11.0	-163,565	9.9	-137,566	7.9	-148,613	8.8
5	40.1	36.1	-162,288	10.2	-167,083	10.3	-161,443	9.2	-133,839	7.3	-146,696	8.3
6	39.8	36.0	-157,214	9.7	-165,154	9.8	-154,537	8.6	-127,536	6.7	-142,182	7.9
7	40.3	36.6	-311,440	9.8	-366,416	9.8	-438,826	8.7	-377,687	7.1	-318,189	8.3
8	41.6	38.2	-190,395	10.0	-228,024	9.9	-267,279	9.0	-266,675	7.8	-250,279	8.9
9	43.8	40.1	-148,513	11.3	-150,559	11.0	-147,608	10.2	-144,135	9.2	-147,799	10.3
10	46.4	41.5	-132,604	12.7	-120,002	12.1	-147,611	11.6	-144,954	10.7	-148,148	11.7
11	49.4	42.9	-123,359	22.7	-131,916	13.2	-119,252	12.9	-148,392	12.3	-113,205	13.9
12	52.4	45.0	-107,020	38.5	-113,130	21.4	-112,979	14.0	-121,618	13.8	-110,944	21.3
13	55.0	46.4	-97,102	51.4	-104,843	32.7	-107,254	28.0	-107,488	29.5	-105,054	32.6
14	57.2	47.2	-90,771	57.0	-98,226	40.1	-100,268	38.7	-100,429	38.5	-98,392	40.0
15	58.5	47.9	-88,145	61.6	-95,016	47.0	-131,598	37.9	-131,734	37.8	-95,144	46.9
16	59.0	47.6	-85,157	65.7	-91,105	50.2	-140,747	16.1	-140,747	16.1	-91,204	50.1
17	58.8	47.7	-80,906	68.1	-86,106	52.9	-141,154	15.9	-141,154	15.8	-86,183	52.9
18	58.0	47.2	-81,549	64.4	-84,765	51.7	-140,390	19.4	-140,390	19.4	-84,825	51.6
19	56.9	47.1	-107,856	49.4	-108,210	40.6	-143,308	17.6	-143,308	17.6	-108,256	40.5
20	55.4	47.2	-117,437	40.4	-114,807	35.8	-147,286	14.5	-147,286	14.5	-114,843	35.8
21	53.6	46.7	-127,001	32.7	-122,661	30.2	-152,061	13.1	-152,061	13.1	-122,689	30.1
22	51.5	45.7	-132,887	27.0	-128,206	26.1	-154,342	12.3	-154,097	12.2	-128,227	26.1
23	49.4	44.5	-173,280	14.3	-163,201	14.4	-154,711	11.5	-154,479	11.5	-163,201	14.4
24	47.3	42.7	-176,197	13.6	-168,771	13.6	-154,587	10.7	-154,368	10.7	-168,771	13.6

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

Month	Design		Weekday		Saturday		Sunday		Monday	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	59.0	53.6	-154,828	14.6	-137,738	15.6	-137,738	14.8	-137,738	12.1
2	56.7	51.7	-152,591	13.9	-143,838	14.6	-143,838	13.7	-141,718	11.5
3	54.6	50.0	-154,978	13.2	-149,408	13.7	-149,408	12.8	-142,815	10.9
4	52.8	48.6	-156,003	12.7	-154,183	12.9	-151,949	12.0	-141,293	10.4
5	51.5	47.5	-154,021	12.2	-155,939	12.3	-150,811	11.3	-137,907	9.8
6	50.7	47.0	-150,709	11.7	-154,378	11.7	-148,747	10.7	-134,109	9.4
7	50.4	46.9	-168,379	11.9	-156,590	15.8	-150,898	10.7	-137,409	18.3
8	51.0	47.8	-148,334	13.7	-156,015	12.8	-149,842	10.9	-141,622	14.7
9	52.5	48.7	-140,125	25.2	-152,334	18.5	-145,875	14.4	-138,308	17.4
10	55.0	49.4	-131,372	39.7	-148,347	28.9	-148,347	25.3	-141,198	27.4
11	58.0	50.7	-120,195	53.5	-119,370	35.5	-140,390	34.3	-140,390	38.6
12	61.4	52.5	-84,765	61.8	-98,165	46.5	-110,547	42.5	-131,372	45.3
13	64.9	54.4	-76,170	66.1	-87,587	52.0	-90,024	51.2	-94,636	50.9
14	67.9	56.1	-71,182	70.9	-79,811	57.3	-81,933	56.6	-82,241	56.4
15	70.4	57.9	-57,894	75.3	-75,498	61.4	-108,562	52.3	-108,562	52.2
16	71.9	58.5	-56,005	79.2	-72,316	64.5	-113,391	19.0	-113,391	18.9
17	72.5	58.8	-50,256	81.1	-66,869	67.4	-108,562	26.4	-108,562	26.3
18	72.2	59.0	-53,258	78.3	-64,300	67.1	-108,562	31.7	-108,562	31.6
19	71.4	59.4	-86,526	63.8	-86,464	56.6	-108,562	26.6	-108,562	26.6
20	70.1	59.9	-96,865	53.5	-91,314	51.0	-108,562	22.8	-108,562	22.8
21	68.3	60.0	-107,184	45.5	-99,240	45.5	-114,685	19.7	-114,685	19.7
22	66.2	58.8	-113,795	39.4	-104,914	41.3	-125,647	17.0	-125,647	17.0
23	63.9	57.5	-143,308	16.6	-124,741	17.2	-124,741	14.4	-124,741	14.4
24	61.4	55.5	-146,756	15.7	-131,372	16.1	-131,372	12.8	-131,372	12.8

Month	Design		Weekday		Saturday		Sunday		Monday	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	62.7	58.8	-125,537	16.1	-127,924	16.2	-127,924	15.7	-127,924	13.2
2	61.1	57.4	-128,189	15.3	-132,168	15.3	-132,168	14.6	-132,168	12.6
3	60.1	56.5	-130,311	14.5	-134,820	14.5	-134,820	13.7	-134,820	12.0
4	59.7	56.2	-131,903	13.9	-135,881	13.9	-135,881	13.1	-135,881	11.7
5	60.1	56.5	-132,433	13.4	-134,820	13.4	-134,820	12.6	-134,723	11.4
6	61.1	57.6	-131,372	13.0	-132,168	13.0	-132,168	12.2	-131,670	11.3
7	62.7	59.2	-128,720	35.4	-127,924	33.0	-127,924	24.3	-127,924	39.6
8	64.7	61.1	-123,945	31.7	-122,619	27.4	-122,619	21.0	-122,619	30.9
9	67.1	62.3	-117,049	46.8	-116,254	40.3	-116,254	34.3	-116,254	42.2
10	69.7	63.6	-109,092	56.6	-109,357	49.5	-109,357	48.0	-109,357	50.5
11	72.3	64.8	-108,562	63.5	-108,562	55.6	-108,562	54.2	-108,562	55.3
12	74.7	65.6	-108,506	68.7	-108,562	59.9	-108,562	58.8	-108,562	58.5
13	76.8	66.5	-58,210	72.9	-84,370	64.1	-108,506	63.2	-108,562	62.9
14	78.4	66.6	-41,324	77.1	-71,868	67.9	-74,195	67.3	-85,811	67.2
15	79.4	66.9	-42,044	81.1	-65,930	71.7	-106,800	62.8	-106,860	62.7
16	79.7	66.4	-39,994	84.7	-56,502	73.2	-114,418	21.4	-114,418	21.3
17	79.4	65.7	-35,272	86.5	-51,209	75.0	-108,562	34.9	-108,562	34.9
18	78.4	65.0	-36,900	85.0	-51,919	73.9	-108,562	36.5	-108,562	36.5
19	76.8	64.8	-73,420	73.5	-82,624	65.7	-108,562	34.9	-108,562	34.9
20	74.7	65.4	-84,367	63.3	-87,139	58.1	-108,562	30.7	-108,562	30.7
21	72.3	65.0	-93,056	54.4	-93,912	51.5	-108,562	25.4	-108,562	25.4
22	69.7	63.7	-99,761	48.3	-97,801	46.3	-109,357	20.8	-109,357	20.8
23	67.1	62.0	-122,198	18.3	-116,254	18.2	-116,254	17.5	-116,254	17.5
24	64.7	60.4	-122,885	17.3	-122,619	17.1	-122,619	14.6	-122,619	14.6

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

Day	----- Design -----				----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	73.3	68.9	-108,562	17.4	-108,562	19.0	-108,562	18.3	-108,562	19.5	-108,562	22.2
2	71.3	67.4	-110,949	16.5	-108,562	20.2	-108,562	18.3	-108,562	17.2	-108,562	20.5
3	69.6	66.1	-113,336	15.7	-109,623	18.0	-109,623	16.7	-109,623	15.4	-109,623	18.4
4	68.1	64.9	-114,927	15.9	-113,601	15.9	-113,601	14.7	-113,601	13.6	-113,601	15.9
5	67.0	64.3	-115,458	14.4	-116,519	14.6	-116,519	14.0	-116,519	13.0	-116,519	13.9
6	66.4	63.8	-114,397	14.0	-118,110	13.9	-118,110	13.2	-118,110	12.4	-118,904	13.3
7	66.1	63.9	-111,744	64.6	-118,906	63.3	-118,906	57.2	-118,906	70.5	-118,906	73.8
8	66.8	63.8	-108,562	44.5	-117,049	37.1	-117,049	34.9	-117,049	38.4	-117,049	42.6
9	68.6	63.8	-108,562	58.1	-112,275	47.3	-112,275	42.8	-112,275	48.0	-112,275	49.8
10	71.3	64.6	-108,562	65.0	-108,562	55.0	-108,562	51.2	-108,562	55.5	-108,562	57.2
11	74.7	66.3	-108,506	70.7	-108,562	59.3	-108,562	57.3	-108,562	60.8	-108,562	62.3
12	78.4	68.1	-82,499	75.6	-108,506	64.1	-108,506	63.1	-108,562	65.7	-108,506	67.1
13	81.8	69.9	-37,443	79.7	-85,127	69.2	-108,506	68.5	-108,506	70.0	-97,835	71.2
14	84.5	70.9	-26,837	83.5	-46,104	74.8	-57,260	74.4	-71,230	75.3	-49,251	76.2
15	86.3	71.8	-27,265	87.6	-43,421	78.6	-92,845	69.9	-92,837	73.6	-43,424	79.9
16	87.0	71.6	-25,488	90.7	-42,140	80.4	-108,562	23.4	-108,562	23.4	-42,141	81.4
17	86.7	72.0	-19,186	92.8	-36,394	82.4	-108,562	41.7	-108,562	41.7	-36,394	83.2
18	86.1	71.7	-19,776	91.9	-35,034	82.1	-108,562	43.6	-108,562	43.7	-35,034	82.9
19	85.0	71.9	-54,338	82.2	-66,100	74.8	-108,562	45.1	-108,562	45.2	-66,100	75.8
20	83.5	72.5	-70,363	72.0	-76,983	67.7	-108,562	39.2	-108,562	39.3	-76,983	69.8
21	81.8	72.9	-88,545	62.3	-90,042	61.6	-108,562	34.3	-108,562	34.4	-90,042	62.7
22	79.8	72.1	-93,358	56.0	-93,413	57.3	-108,562	30.4	-108,562	30.5	-93,413	57.6
23	77.6	71.2	-111,868	19.8	-111,841	20.9	-108,562	26.3	-108,562	26.4	-111,840	21.1
24	75.5	69.9	-110,879	18.7	-110,867	19.8	-108,562	22.8	-108,562	22.9	-110,867	20.0

e	----- Design -----				----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
ur	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	78.8	73.3	-108,562	21.0	-108,562	27.0	-108,562	26.3	-108,562	28.4	-108,562	33.2
2	76.6	71.9	-108,562	23.0	-108,562	24.7	-108,562	23.5	-108,562	24.5	-108,562	28.8
3	74.6	70.6	-108,562	20.9	-108,562	22.3	-108,562	21.1	-108,562	21.0	-108,562	24.9
4	73.0	69.2	-108,562	19.2	-108,562	19.9	-108,562	18.8	-108,562	18.4	-108,562	21.3
5	71.7	68.1	-108,562	17.9	-108,562	18.1	-108,562	16.9	-108,562	16.4	-108,562	18.8
6	71.0	67.5	-108,562	17.0	-108,562	16.7	-108,562	15.6	-109,683	15.0	-108,562	17.1
7	70.7	67.5	-108,562	79.9	-108,562	77.2	-108,562	74.0	-108,562	79.5	-108,562	81.4
8	71.2	67.0	-108,562	51.5	-108,562	44.5	-108,562	40.7	-108,562	47.8	-108,562	50.8
9	72.7	66.6	-108,562	64.2	-108,562	52.7	-108,562	50.8	-108,562	53.1	-108,562	54.6
10	75.0	66.9	-108,506	72.1	-108,562	61.1	-108,562	59.1	-108,562	61.4	-108,562	62.8
11	77.9	67.5	-91,234	78.0	-108,506	66.2	-108,562	62.7	-108,562	66.4	-108,506	67.7
12	81.2	68.7	-67,366	81.9	-108,506	70.5	-108,506	67.9	-108,506	70.7	-108,506	71.9
13	84.4	69.9	-23,629	84.6	-56,549	74.3	-90,534	73.0	-97,351	74.7	-71,751	75.6
14	87.3	71.0	-17,762	88.3	-36,386	78.3	-39,075	77.8	-46,337	78.9	-36,377	79.6
15	89.7	71.7	-18,350	91.8	-35,786	82.7	-85,218	73.9	-85,216	78.1	-35,790	83.9
16	91.1	72.8	-16,527	95.4	-34,007	85.1	-108,562	24.5	-108,562	24.7	-34,007	86.1
17	91.7	72.8	-10,375	97.7	-26,666	87.4	-108,562	46.4	-108,562	46.5	-26,666	88.3
18	91.4	72.6	-8,618	96.8	-24,610	87.8	-108,562	50.6	-108,562	50.7	-24,610	88.7
19	90.6	73.2	-41,736	88.3	-55,139	81.9	-108,562	51.4	-108,562	51.5	-55,139	82.9
20	89.4	74.1	-59,204	77.8	-66,633	74.7	-108,562	45.5	-108,562	45.6	-66,633	76.9
21	87.7	75.7	-79,127	68.2	-81,481	68.9	-108,562	40.9	-108,562	41.0	-81,481	70.5
22	85.7	76.0	-91,068	61.9	-90,848	64.8	-108,562	37.2	-108,562	37.3	-90,848	65.2
23	83.5	75.3	-112,489	21.4	-112,607	23.4	-108,562	34.3	-108,562	35.3	-112,607	23.8
24	81.2	74.2	-111,424	20.4	-111,534	22.1	-108,562	32.4	-108,562	32.6	-111,534	22.6

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

July	----- Design -----				----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	82.5	74.8	-108,562	28.5	-108,562	30.6	-108,562	29.4	-108,562	33.3	-108,562	38.0
2	80.3	73.7	-108,562	26.2	-108,562	28.0	-108,562	26.8	-108,562	29.6	-108,562	33.8
3	78.2	72.8	-108,562	24.1	-108,562	25.5	-108,562	24.4	-108,562	26.0	-108,562	29.9
4	76.5	71.6	-108,562	22.4	-108,562	23.4	-108,562	22.3	-108,562	23.1	-108,562	26.5
5	75.3	70.8	-108,562	20.8	-108,562	21.4	-108,562	20.4	-108,562	20.6	-108,562	23.5
6	74.5	70.4	-108,562	20.2	-108,562	19.7	-108,562	18.7	-108,562	18.7	-108,562	20.9
7	74.2	70.4	-108,562	86.8	-108,562	84.9	-108,562	82.7	-108,562	86.1	-108,562	87.8
8	74.7	70.5	-108,562	60.7	-108,562	54.0	-108,562	49.8	-108,562	54.3	-108,562	56.5
9	76.3	70.6	-108,562	69.0	-108,562	57.9	-108,562	56.0	-108,562	57.9	-108,562	59.5
10	78.6	70.9	-108,506	77.6	-108,562	66.4	-108,562	64.8	-108,562	66.5	-108,562	67.9
11	81.6	71.2	-85,361	83.7	-108,506	71.9	-108,506	70.5	-108,562	71.9	-108,506	73.2
12	84.9	71.9	-58,220	88.0	-101,237	76.0	-108,506	73.4	-108,506	76.0	-104,741	77.2
13	88.2	72.7	-18,548	90.7	-41,473	79.6	-69,464	78.1	-83,512	79.9	-52,702	80.8
14	91.2	73.2	-12,911	94.0	-30,648	83.9	-33,343	83.2	-33,690	84.4	-30,643	85.0
15	93.6	73.9	-13,397	97.3	-29,614	88.4	-79,045	79.4	-79,049	83.5	-29,618	89.6
16	95.1	73.7	-11,554	100.7	-26,703	91.5	-108,562	26.1	-108,562	26.2	-26,703	92.6
17	95.7	73.9	-6,132	103.0	-19,645	94.6	-108,562	52.9	-108,562	53.1	-19,645	95.7
18	95.4	73.8	-5,999	101.9	-18,199	95.3	-108,562	59.5	-108,562	59.6	-18,199	96.4
19	94.6	73.9	-38,437	92.6	-48,648	88.8	-108,562	57.4	-108,562	57.5	-48,648	89.6
20	93.3	74.7	-55,336	82.2	-60,255	81.8	-108,562	51.0	-108,562	51.1	-60,255	82.9
21	91.6	76.0	-75,866	73.2	-75,397	74.4	-108,562	45.9	-108,562	46.0	-75,397	76.5
22	89.6	76.6	-87,844	65.6	-84,769	70.1	-108,562	45.0	-108,562	46.2	-84,769	70.5
23	87.3	76.3	-112,961	22.7	-113,208	24.9	-108,562	42.6	-108,562	42.7	-113,209	25.3
24	84.9	75.6	-108,562	23.4	-108,562	27.1	-108,562	38.0	-108,562	38.1	-108,562	27.4

August	----- Design -----				----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	82.5	75.9	-108,562	29.3	-108,562	31.1	-108,562	30.1	-108,562	33.7	-108,562	38.4
2	80.3	74.9	-108,562	27.0	-108,562	28.6	-108,562	27.5	-108,562	30.1	-108,562	34.3
3	78.4	73.6	-108,562	24.9	-108,562	25.9	-108,562	24.8	-108,562	26.4	-108,562	30.2
4	76.8	72.4	-108,562	23.2	-108,562	24.1	-108,562	23.0	-108,562	23.9	-108,562	27.3
5	75.6	71.4	-108,562	22.0	-108,562	21.9	-108,562	20.8	-108,562	20.9	-108,562	23.9
6	74.9	70.9	-108,562	21.1	-108,562	20.5	-108,562	19.5	-108,562	19.5	-108,562	21.8
7	74.6	71.0	-108,562	87.3	-108,562	85.5	-108,562	83.3	-108,562	86.4	-108,562	87.7
8	75.1	71.3	-108,562	61.8	-108,562	53.5	-108,562	49.2	-108,562	54.0	-108,562	56.4
9	76.5	71.4	-108,562	68.5	-108,562	57.8	-108,562	55.9	-108,562	57.9	-108,562	59.4
10	78.8	71.6	-108,506	77.7	-108,562	66.5	-108,562	64.9	-108,562	66.6	-108,562	68.0
11	81.6	72.2	-103,503	85.2	-108,506	72.4	-108,562	70.9	-108,562	72.4	-108,562	73.7
12	84.7	73.4	-65,462	90.3	-108,506	77.4	-108,506	74.6	-108,506	77.5	-108,506	78.8
13	87.9	74.2	-22,779	93.4	-52,285	81.6	-86,063	80.1	-97,456	82.0	-67,074	83.1
14	90.7	75.1	-18,363	97.4	-35,145	86.6	-37,834	86.0	-41,069	87.4	-35,137	88.2
15	92.9	75.6	-18,601	101.3	-34,163	91.6	-83,596	81.7	-83,597	86.0	-34,168	93.1
16	94.3	75.2	-16,645	103.8	-32,167	92.9	-108,562	26.7	-108,562	26.7	-32,167	94.3
17	94.8	74.9	-11,692	105.4	-24,726	96.1	-108,562	53.2	-108,562	53.3	-24,726	97.5
18	94.6	74.4	-13,231	103.3	-24,437	95.4	-108,562	59.7	-108,562	59.8	-24,437	96.7
19	93.8	74.6	-49,660	90.5	-56,791	87.4	-108,562	55.7	-108,562	55.8	-56,791	88.4
20	92.6	75.7	-64,102	81.3	-66,921	80.5	-108,562	49.9	-108,562	50.0	-66,921	82.1
21	91.0	77.2	-81,388	72.4	-80,550	74.5	-108,562	45.9	-108,562	46.0	-80,550	76.3
22	89.1	77.6	-90,785	65.6	-88,171	69.7	-108,562	42.4	-108,562	43.5	-88,171	70.1
23	87.0	77.3	-112,857	23.4	-113,014	25.8	-108,562	42.3	-108,562	42.4	-113,015	26.2
24	84.7	76.9	-108,562	23.5	-108,562	26.8	-108,562	37.9	-108,562	38.0	-108,562	27.2



BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

September			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	76.3	71.3	-108,562	25.9	-108,562	23.3	-108,562	21.4	-108,562	24.2	-108,562	26.8
2	74.7	70.5	-108,562	23.6	-108,562	24.3	-108,562	23.1	-108,562	21.4	-108,562	26.7
3	73.2	69.4	-108,562	21.7	-108,562	22.1	-108,562	20.9	-108,562	19.4	-108,562	23.5
4	72.0	68.6	-108,562	20.3	-108,562	20.4	-108,562	19.2	-108,562	18.0	-108,562	20.9
5	71.1	68.0	-108,562	18.8	-108,562	18.7	-108,562	17.6	-108,562	16.5	-108,562	18.8
6	70.6	67.7	-108,562	18.2	-108,562	17.4	-108,562	16.3	-108,562	15.5	-108,562	17.3
7	70.4	67.9	-108,562	80.9	-108,562	77.9	-108,562	69.7	-108,562	80.9	-108,562	82.9
8	70.9	68.6	-108,562	49.3	-108,562	41.9	-108,562	39.7	-108,562	46.1	-108,562	49.4
9	72.4	68.5	-108,562	61.9	-108,562	52.4	-108,562	49.9	-108,562	52.9	-108,562	54.5
10	74.7	69.3	-108,562	71.6	-108,562	61.4	-108,562	57.3	-108,562	61.8	-108,562	63.3
11	77.4	70.7	-108,506	79.4	-108,562	67.4	-108,562	64.1	-108,562	67.8	-108,562	69.2
12	80.4	71.5	-107,954	84.5	-108,562	71.1	-108,562	69.5	-108,562	72.3	-108,562	73.7
13	83.2	73.2	-47,802	88.7	-89,613	76.8	-108,506	76.0	-108,506	77.8	-102,583	79.1
14	85.4	73.8	-33,513	94.2	-61,438	83.5	-74,852	83.1	-85,702	84.4	-64,758	85.4
15	86.9	74.0	-34,114	98.1	-48,013	86.5	-98,502	76.6	-101,302	80.8	-48,015	88.2
16	87.4	73.6	-32,568	101.1	-47,245	87.7	-108,562	25.8	-108,562	25.8	-47,247	89.0
17	87.2	73.5	-28,157	103.3	-40,611	89.2	-108,562	45.7	-108,562	45.7	-40,611	90.4
18	86.7	73.0	-30,761	97.1	-41,257	86.8	-108,562	49.7	-108,562	49.7	-41,257	87.8
19	85.8	73.7	-68,612	81.7	-75,286	76.3	-108,562	46.1	-108,562	46.1	-75,286	77.6
20	84.6	74.6	-80,546	72.4	-84,230	70.3	-108,562	41.5	-108,562	41.5	-84,230	72.8
21	83.2	74.7	-90,253	64.5	-90,578	64.5	-108,562	36.9	-108,562	37.0	-90,578	65.4
22	81.5	74.9	-93,779	59.7	-93,618	60.9	-108,562	33.7	-108,562	33.8	-93,618	61.2
23	79.8	73.5	-111,985	22.3	-111,927	24.1	-108,562	30.2	-108,562	30.3	-111,927	24.3
24	78.0	72.7	-111,043	21.3	-110,987	23.1	-108,562	27.0	-108,562	27.1	-110,988	23.3

October		----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----		
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	59.6	54.2	-140,921	16.0	-136,146	16.7	-136,146	16.1	-136,146	13.4	-136,146	13.7
2	56.9	53.0	-144,634	15.4	-143,308	15.7	-143,308	14.9	-142,462	12.7	-143,308	13.2
3	54.9	51.3	-147,286	14.4	-148,613	14.5	-148,613	13.7	-143,482	11.8	-146,093	12.5
4	53.6	50.6	-149,408	13.8	-152,061	13.8	-151,614	13.0	-142,643	11.4	-146,583	12.1
5	53.1	50.4	-149,939	13.5	-153,387	13.3	-149,624	12.4	-139,627	10.9	-145,524	11.8
6	53.6	50.8	-148,613	13.1	-150,531	12.9	-146,079	12.0	-138,390	10.7	-142,788	11.6
7	54.9	52.2	-145,164	24.0	-151,404	20.4	-151,261	12.5	-137,143	21.5	-139,695	26.1
8	56.9	54.3	-139,064	22.3	-146,289	15.8	-142,601	14.3	-132,106	21.5	-139,349	25.0
9	59.6	55.8	-130,046	37.8	-136,146	27.7	-136,146	23.8	-132,166	30.6	-136,146	37.1
10	62.8	55.9	-119,702	52.8	-127,659	37.4	-127,659	34.1	-127,659	39.8	-127,659	44.3
11	66.1	56.9	-108,562	61.2	-118,906	50.4	-118,906	47.3	-118,906	48.2	-118,906	51.7
12	69.5	58.5	-101,887	68.5	-95,500	56.5	-109,888	55.3	-109,888	54.7	-109,888	56.0
13	72.7	60.0	-75,340	75.2	-78,730	62.6	-92,636	61.7	-108,562	61.3	-83,461	62.3
14	75.4	61.2	-70,280	82.4	-74,277	69.3	-76,272	68.5	-77,289	68.3	-74,463	68.9
15	77.4	62.2	-55,376	87.5	-72,373	71.9	-108,562	62.3	-108,562	62.1	-72,517	71.5
16	78.7	62.7	-51,424	90.5	-69,142	74.7	-114,325	21.6	-114,325	21.5	-69,253	74.4
17	79.2	62.8	-47,487	89.6	-63,960	76.7	-108,562	34.1	-108,562	33.9	-64,046	76.4
18	78.7	62.9	-53,003	79.3	-62,333	72.5	-108,562	34.7	-108,562	34.6	-62,400	72.3
19	77.4	63.4	-83,487	65.4	-85,486	62.9	-108,562	34.8	-108,562	34.7	-85,538	62.7
20	75.4	63.9	-91,419	56.1	-89,756	56.9	-108,562	29.5	-108,562	29.4	-89,796	56.7
21	72.7	63.2	-101,580	48.3	-95,231	51.2	-108,562	25.1	-108,562	25.1	-95,261	51.0
22	69.5	61.4	-108,328	42.6	-99,024	46.1	-109,888	20.5	-109,888	20.4	-99,048	45.9
23	66.1	59.5	-133,494	17.9	-118,906	19.3	-118,906	17.1	-118,906	17.0	-118,906	19.1
24	62.8	56.6	-137,473	16.8	-127,659	17.8	-127,659	14.5	-127,659	14.4	-127,659	17.7

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 1  
EXISTING CONDITIONS

Month	----- Design -----				----- Weekday -----				----- Saturday-----				----- Sunday -----				----- Monday -----			
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	58.2	54.3	-147,021	15.0	-139,860	15.9	-139,860	15.2	-137,843	12.4	-138,351	12.8								
2	56.0	52.3	-149,673	14.3	-145,695	15.0	-145,695	14.1	-139,293	11.8	-141,068	12.3								
3	54.2	50.7	-151,795	13.7	-150,469	14.0	-150,469	13.1	-139,686	11.1	-142,499	11.8								
4	52.8	49.5	-153,652	13.1	-154,183	13.4	-149,664	12.4	-137,126	10.6	-142,836	11.4								
5	51.9	49.0	-152,151	12.7	-153,336	12.8	-147,909	11.8	-133,681	10.2	-142,103	11.0								
6	51.6	48.8	-148,847	12.3	-151,123	12.3	-145,215	11.3	-129,959	9.8	-140,306	10.7								
7	52.0	49.4	-149,797	16.8	-153,261	15.4	-147,281	11.4	-146,453	18.5	-143,346	20.5								
8	53.2	50.6	-145,868	14.5	-149,429	13.9	-142,968	11.6	-137,200	11.6	-140,740	19.9								
9	55.2	52.0	-138,268	23.7	-145,787	19.6	-139,104	14.5	-134,894	17.1	-138,622	18.9								
10	57.6	53.3	-130,046	41.1	-141,451	24.9	-141,058	21.0	-134,548	25.0	-138,729	31.4								
11	60.4	53.9	-121,028	54.5	-128,537	35.7	-134,024	32.9	-134,024	37.2	-134,024	40.1								
12	63.3	55.2	-96,460	60.6	-96,608	45.6	-121,429	42.3	-126,333	43.8	-114,106	45.0								
13	66.1	56.5	-78,383	66.8	-87,036	50.7	-89,484	49.9	-106,138	49.5	-87,463	50.4								
14	68.5	57.8	-74,038	73.1	-79,801	55.6	-81,876	54.9	-82,152	54.7	-80,136	55.3								
15	70.4	58.7	-71,827	78.2	-76,267	59.6	-108,562	50.4	-108,562	50.3	-76,525	59.3								
16	71.6	59.4	-68,299	80.7	-73,157	63.1	-112,962	19.0	-112,962	18.9	-73,357	62.8								
17	72.1	59.5	-63,576	79.7	-68,394	64.4	-108,562	21.9	-108,562	21.8	-68,548	64.2								
18	71.8	60.2	-64,595	68.1	-67,092	60.1	-108,562	26.1	-108,562	26.0	-67,212	59.8								
19	70.9	61.4	-92,342	55.9	-90,177	51.6	-108,562	23.1	-108,562	23.0	-90,270	51.4								
20	69.5	61.8	-100,336	48.4	-94,333	47.5	-109,888	20.4	-109,888	20.3	-94,404	47.3								
21	67.6	61.6	-109,249	42.0	-101,700	43.2	-114,927	18.3	-114,927	18.2	-101,756	43.0								
22	65.5	60.0	-114,946	37.0	-106,877	39.1	-120,497	15.6	-120,497	15.5	-106,920	38.9								
23	63.1	58.5	-140,921	16.9	-126,863	18.0	-126,863	14.3	-126,863	14.2	-126,863	17.8								
24	60.6	55.9	-144,369	15.9	-133,494	16.7	-133,494	13.3	-133,494	13.3	-133,494	16.6								

Month	----- Design -----				----- Weekday -----				----- Saturday-----				----- Sunday -----				----- Monday -----			
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	48.2	44.6	-171,187	12.5	-166,384	13.9	-165,588	13.1	-147,957	10.4	-152,010	10.7								
2	46.1	42.8	-169,473	11.9	-169,897	13.0	-164,656	12.0	-144,523	9.6	-149,453	10.1								
3	44.2	41.1	-166,918	11.1	-169,153	12.2	-163,043	11.1	-139,678	8.9	-148,171	9.6								
4	42.6	39.7	-163,744	10.5	-167,444	11.4	-160,654	10.3	-134,201	8.1	-145,247	9.0								
5	41.4	38.7	-162,146	10.0	-164,802	10.6	-159,582	9.4	-130,807	7.4	-143,656	8.4								
6	40.7	37.8	-156,905	9.6	-161,244	10.0	-150,603	8.8	-124,330	6.8	-138,976	7.9								
7	40.4	37.7	-203,903	9.8	-300,269	9.9	-375,166	8.7	-296,757	7.0	-224,607	8.2								
8	41.1	38.2	-211,592	10.1	-243,126	9.9	-260,758	9.0	-267,486	7.6	-261,398	8.8								
9	43.1	40.1	-142,008	11.5	-151,309	11.1	-148,297	10.2	-143,862	9.1	-148,476	10.1								
10	46.1	42.3	-157,281	13.0	-121,976	12.2	-147,040	11.6	-144,990	10.6	-161,016	11.5								
11	49.8	44.5	-111,700	24.1	-112,872	13.3	-120,734	12.9	-146,057	12.2	-119,473	18.4								
12	53.7	46.6	-103,896	38.8	-113,167	21.1	-112,481	14.2	-131,115	14.7	-110,879	20.8								
13	57.4	49.0	-93,626	53.5	-102,410	27.6	-104,826	24.5	-105,016	26.1	-102,631	27.3								
14	60.4	50.9	-87,006	59.7	-94,620	39.6	-96,666	38.1	-96,797	38.0	-94,793	39.4								
15	62.4	52.0	-84,149	64.2	-90,299	48.5	-126,885	39.4	-126,995	39.3	-90,433	48.3								
16	63.0	52.1	-81,318	67.8	-86,308	51.7	-130,140	16.6	-130,140	16.5	-86,412	51.5								
17	62.8	51.6	-77,998	67.3	-81,348	53.3	-130,314	16.2	-130,314	16.1	-81,429	53.1								
18	62.1	51.6	-80,407	56.8	-80,833	48.6	-129,893	15.6	-129,893	15.5	-80,896	48.4								
19	60.9	51.8	-108,480	44.5	-105,272	39.7	-132,698	16.1	-132,698	16.0	-105,320	39.5								
20	59.3	52.1	-116,930	37.2	-110,680	35.9	-136,942	14.2	-136,942	14.1	-110,718	35.7								
21	57.4	51.8	-125,745	30.8	-118,246	31.4	-141,982	13.4	-141,982	13.4	-118,275	31.2								
22	55.2	50.7	-131,461	25.8	-123,443	27.6	-145,533	12.7	-145,334	12.6	-123,465	27.5								
23	52.9	48.9	-169,566	14.4	-153,917	15.2	-146,793	12.0	-146,604	11.9	-153,917	15.1								
24	50.5	46.7	-173,014	13.7	-160,283	14.3	-147,638	11.1	-147,460	11.0	-160,283	14.2								

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 GL)	GAS DMND On Peak (Thrm/hr)
Jan	67,572	194	1,307	36	6
Feb	59,019	192	1,204	31	5
March	80,990	208	1,065	67	2
April	85,713	218	930	88	2
May	97,768	229	858	113	1
June	102,010	235	778	126	1
July	109,890	242	796	142	1
Aug	112,441	246	798	145	1
Sept	98,607	239	837	118	1
Oct	86,017	220	1,027	81	2
Nov	76,567	209	1,032	57	2
Dec	66,386	196	1,275	32	5
Total	1,042,981	246	11,908	1,036	6

Building Energy Consumption = 133,290 (Btu/Sq Ft/Year)  
Source Energy Consumption = 334,837 (Btu/Sq Ft/Year)

Floor Area = 35,640 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref Num	Equip Code	Monthly Consumption												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	31114	28120	32183	29938	31648	31007	30579	32183	29938	31648	29938	30579	368,874
	PK	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1131L	WTR-CLD COND COMP W-EVAP COND >30 TONS												
	ELEC	7917	6886	14472	19250	24873	27467	31221	31793	26010	17286	12426	7017	226,617
	PK	49.6	49.5	58.3	64.6	71.9	75.2	79.5	81.6	79.7	66.3	59.1	49.3	81.6
1	EQ5105	COOLING TOWER												
	ELEC	4204	2071	8173	9824	11605	12976	14491	14511	11933	9456	8760	4300	112,306
	PK	20.5	16.4	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
1	EQ5105	COOLING TOWER												
	WATER	34	29	65	85	111	123	139	142	115	78	54	30	1,006
	PK	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4
1	EQ5302	CONTROLS												
	ELEC	29	25	46	48	57	63	71	71	58	46	43	26	583
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	EQ1100S	AIR-CLD RECIP 25-45 TONS												
	ELEC	16615	15000	18039	18458	20788	21734	24143	24546	21847	19193	17573	16747	234,684
	PK	26.2	26.4	28.5	31.5	35.2	38.0	40.9	41.4	37.6	32.0	28.4	26.4	41.4
	EQ5200	CONDENSER FANS												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	ELEC	671	575	1054	1400	1776	1968	2363	2315	2026	1366	1034	696	17,243
	PK	1.5	1.4	2.7	3.1	3.3	3.5	4.9	4.9	3.6	3.2	2.6	1.6	4.9
2	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	2219	2004	2219	2148	2219	2148	2219	2219	2148	2219	2148	2219	26,129
	PK	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
2	EQ5303	CONTROLS												
	ELEC	223	202	223	216	223	216	223	223	216	223	216	223	2,628
	PK	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
1	EQ2002	GAS FIRE TUBE STEAM												
	GAS	1307	1204	1065	930	858	778	796	798	837	1027	1032	1275	11,908
	PK	6.3	5.3	2.0	1.6	1.4	1.4	1.4	1.4	1.3	1.8	1.9	4.5	6.3
1	EQ5020	HEAT WATER CIRC. PUMP C.V.												
	ELEC	3699	3341	3699	3579	3699	3579	3699	3699	3579	3699	3579	3699	43,549
	PK	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	486	439	486	470	486	470	486	486	470	486	470	486	5,720
	PK	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
1	EQ5307	BOILER CONTROLS												
	ELEC	372	336	372	360	372	360	372	372	360	372	360	372	4,380
	PK	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	EQ5061	CONDENSATE RETURN PUMP												
	ELEC	23	21	23	22	23	22	23	23	22	23	22	23	269
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5406	MAKE-UP WATER												
	WATER	3	2	3	2	3	2	3	3	2	3	2	3	30
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 246.0 (kW)  
Yearly Time of Peak 16 (hr) 8 (mo)  
Hour 16 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
Cooling Equipment				
1	EQ1131L	WTR-CLD COND COMP W-EVAP COND >30 TONS	101.7	41.34
2	EQ1100S	AIR-CLD RECIP 25-45 TONS	49.0	19.94
Sub Total			150.7	61.28
Heating Equipment				
1	EQ2002	GAS FIRE TUBE STEAM	6.2	2.50
Sub Total			6.2	2.50
Sub Total			0.0	0.00
Sub Total			0.0	0.00
Miscellaneous				
Lights			89.1	36.22
Base Utilities			0.0	0.00
Misc Equipment			0.0	0.00
Sub Total			89.1	36.22
Grand Total			246.0	100.00

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

January			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	41.3	36.7	-28,758	0.0	-29,994	0.0	-33,138	0.0	-37,149	0.0	-37,355	0.0
2	40.0	36.0	-31,932	0.0	-36,437	0.0	-40,876	0.0	-46,861	0.0	-39,071	0.0
3	39.5	35.9	-34,609	0.0	-39,968	0.0	-47,541	0.0	-51,060	0.0	-45,037	0.0
4	39.9	36.4	-36,506	0.0	-41,115	0.0	-46,594	0.0	-51,211	0.0	-44,827	0.0
5	40.8	37.6	-37,178	0.0	-43,555	0.0	-49,251	0.0	-51,082	0.0	-45,336	0.0
6	42.4	39.4	-21,847	0.0	0	0.0	-7,361	0.0	-10,002	0.0	-1,897	0.0
7	44.4	41.5	-523,029	5.5	-323,186	10.1	-443,428	9.2	-356,032	9.0	-245,556	9.6
8	46.9	44.1	-328,475	6.5	-197,943	10.5	-228,125	9.7	-213,162	9.6	-203,250	10.1
9	49.5	46.6	-133,331	8.3	-141,654	11.6	-139,518	10.9	-139,505	10.8	-139,749	11.3
10	52.2	48.2	-143,203	10.2	-134,989	12.8	-142,038	12.2	-142,001	12.2	-141,814	14.2
11	54.9	49.2	-141,632	16.4	-113,754	16.1	-135,105	13.7	-140,533	13.6	-112,197	20.2
12	57.3	50.1	-139,860	29.1	-107,249	26.1	-109,978	17.8	-109,982	22.6	-107,400	26.0
13	59.4	50.4	-132,698	41.2	-98,269	34.9	-100,572	32.9	-100,575	33.6	-98,385	34.8
14	60.9	50.0	-88,095	47.4	-92,536	46.0	-94,500	45.1	-94,503	45.1	-92,628	45.9
15	61.9	50.3	-85,061	51.7	-89,757	49.1	0	0.0	0	0.0	-89,828	49.0
16	62.2	49.8	-82,135	64.1	-86,482	52.2	-2,804	0.0	-2,804	0.0	-86,536	52.1
17	61.8	49.3	-78,702	68.1	-82,101	54.1	0	0.0	0	0.0	-82,143	54.1
18	60.4	48.6	-80,089	61.1	-82,143	51.5	0	0.0	0	0.0	-82,175	51.5
19	58.3	48.2	-107,846	47.0	-107,416	40.3	0	0.0	0	0.0	-107,441	40.3
20	55.6	46.8	-116,946	39.1	-114,792	34.7	0	0.0	0	0.0	-114,811	34.7
21	52.5	44.9	-126,166	31.5	-124,222	28.6	0	0.0	0	0.0	-124,237	28.6
22	49.3	42.5	-132,372	26.2	-131,024	23.9	0	0.0	0	0.0	-131,036	23.9
23	46.2	40.4	-48,813	0.0	-51,607	0.0	-11,092	0.0	-11,104	0.0	-51,681	0.0
24	43.5	38.5	-11,130	0.0	-19,563	0.0	-26,313	0.0	-26,316	0.0	-19,636	0.0

February		----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----		
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	45.2	40.8	-25,919	0.0	-13,355	0.0	-21,387	0.0	-25,859	0.0	-25,462	0.0
2	43.4	39.0	-28,052	0.0	-25,342	0.0	-30,552	0.0	-34,215	0.0	-29,215	0.0
3	41.9	37.4	-32,950	0.0	-32,585	0.0	-38,368	0.0	-43,905	0.0	-37,885	0.0
4	40.8	36.7	-37,128	0.0	-38,167	0.0	-44,147	0.0	-45,985	0.0	-40,518	0.0
5	40.1	36.1	-40,004	0.0	-42,398	0.0	-50,462	0.0	-49,991	0.0	-46,919	0.0
6	39.8	36.0	0	0.0	0	0.0	0	0.0	-9,716	0.0	0	0.0
7	40.3	36.6	-288,168	9.8	-338,538	9.8	-448,964	8.7	-332,445	8.4	-231,409	9.1
8	41.6	38.2	-190,397	10.0	-228,017	9.9	-249,558	9.0	-242,913	8.8	-235,138	9.4
9	43.8	40.1	-148,109	11.2	-150,395	11.0	-147,602	10.2	-147,582	10.0	-147,835	10.6
10	46.4	41.5	-132,479	12.7	-120,281	12.1	-147,595	11.5	-147,536	11.4	-129,895	13.2
11	49.4	42.9	-114,305	24.3	-114,396	14.3	-121,798	12.9	-131,092	12.8	-112,303	18.5
12	52.4	45.0	-107,052	38.5	-113,004	21.4	-112,971	14.0	-112,866	17.2	-111,033	21.3
13	55.0	46.4	-97,128	51.4	-104,856	32.7	-107,256	30.2	-107,264	32.0	-105,045	32.6
14	57.2	47.2	-90,790	57.0	-98,235	40.1	-100,269	38.7	-100,275	38.7	-98,385	40.0
15	58.5	47.9	-88,160	61.6	-95,023	46.9	0	0.0	0	0.0	-95,138	46.9
16	59.0	47.6	-85,168	65.6	-91,111	50.2	-2,674	0.0	-2,674	0.0	-91,201	50.1
17	58.8	47.7	-80,915	68.1	-86,111	52.9	0	0.0	0	0.0	-86,180	52.9
18	58.0	47.2	-81,556	64.4	-84,769	51.7	0	0.0	0	0.0	-84,823	51.6
19	56.9	47.1	-107,861	49.4	-108,212	40.6	0	0.0	0	0.0	-108,254	40.5
20	55.4	47.2	-117,441	40.4	-114,810	35.8	0	0.0	0	0.0	-114,842	35.8
21	53.6	46.7	-127,005	32.7	-122,663	30.2	0	0.0	0	0.0	-122,688	30.1
22	51.5	45.7	-132,890	27.0	-128,207	26.1	0	0.0	0	0.0	-128,226	26.1
23	49.4	44.5	-48,135	0.0	-38,510	0.0	-7,134	0.0	-7,134	0.0	-38,631	0.0
24	47.3	42.7	-9,907	0.0	-2,405	0.0	-15,414	0.0	-15,421	0.0	-2,525	0.0

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

Month			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	59.0	53.6	-4,742	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	56.7	51.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	54.6	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	52.8	48.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	51.5	47.5	-4,462	0.0	0	0.0	0	0.0	-2,612	0.0	-7,577	0.0
6	50.7	47.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	50.4	46.9	-152,610	12.5	-163,656	18.4	-176,873	12.2	-145,248	30.8	-100,421	37.5
8	51.0	47.8	-150,972	14.1	-163,715	14.3	-159,433	12.2	-158,957	22.4	-179,020	23.9
9	52.5	48.7	-140,125	22.5	-157,088	19.8	-157,050	18.1	-139,334	25.8	-130,391	32.0
10	55.0	49.4	-131,372	40.1	-116,728	28.1	-148,347	24.5	-116,946	32.8	-113,114	38.4
11	58.0	50.7	-106,677	55.9	-106,200	36.9	-119,682	35.0	-108,822	41.5	-105,576	43.8
12	61.4	52.5	-84,648	61.8	-97,735	47.2	-100,555	44.1	-100,003	46.6	-97,186	47.5
13	64.9	54.4	-76,075	66.1	-87,253	52.2	-89,639	51.4	-89,148	51.7	-86,816	52.5
14	67.9	56.1	-67,582	70.9	-79,554	57.5	-81,574	56.8	-81,242	57.0	-79,264	57.7
15	70.4	57.9	-57,896	75.3	-75,299	61.5	0	0.0	0	0.0	-75,074	61.7
16	71.9	58.5	-56,003	79.2	-72,162	64.6	0	0.0	0	0.0	-71,988	64.7
17	72.5	58.8	-50,256	81.1	-66,749	67.5	0	0.0	0	0.0	-66,614	67.6
18	72.2	59.0	-53,258	78.3	-64,207	67.2	0	0.0	0	0.0	-64,103	67.2
19	71.4	59.4	-86,526	63.8	-86,392	56.6	0	0.0	0	0.0	-86,311	56.7
20	70.1	59.9	-96,865	53.5	-91,258	51.0	0	0.0	0	0.0	-91,196	51.0
21	68.3	60.0	-107,184	45.5	-99,197	45.5	0	0.0	0	0.0	-99,148	45.5
22	66.2	58.8	-113,795	39.4	-104,881	41.3	0	0.0	0	0.0	-104,843	41.3
23	63.9	57.5	-13,141	0.0	-9,417	0.0	0	0.0	0	0.0	-9,417	0.0
24	61.4	55.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

Month			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	62.7	58.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	61.1	57.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	60.1	56.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	59.7	56.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	60.1	56.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	61.1	57.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	62.7	59.2	-128,230	37.3	-118,295	34.7	-127,924	25.3	-40,438	74.4	-8,479	83.3
8	64.7	61.1	-123,945	35.4	-122,619	31.1	-122,619	23.6	-98,547	36.8	-56,008	39.0
9	67.1	62.3	-117,049	49.2	-116,254	42.7	-116,254	37.0	-105,553	47.1	-92,001	48.8
10	69.7	63.6	-90,008	58.5	-94,466	51.4	-109,357	49.7	-93,412	54.4	-89,895	55.8
11	72.3	64.8	-83,481	64.7	-86,138	56.9	-108,562	55.7	-88,592	59.2	-85,592	60.5
12	74.7	65.6	-55,311	69.2	-81,486	60.7	-84,757	59.8	-83,622	62.3	-79,956	63.4
13	76.8	66.5	-45,862	73.0	-75,186	64.5	-77,552	63.7	-69,510	64.3	-62,943	66.0
14	78.4	66.6	-41,313	77.1	-59,612	68.2	-73,417	67.6	-59,912	67.7	-57,206	68.9
15	79.4	66.9	-42,040	81.1	-57,793	71.8	0	0.0	0	0.0	-57,790	72.5
16	79.7	66.4	-39,994	84.7	-56,502	73.2	0	0.0	0	0.0	-56,502	73.6
17	79.4	65.7	-35,272	86.5	-51,206	75.0	0	0.0	0	0.0	-51,206	75.2
18	78.4	65.0	-36,900	85.0	-51,918	73.9	0	0.0	0	0.0	-51,918	74.1
19	76.8	64.8	-73,420	73.5	-82,624	65.7	0	0.0	0	0.0	-82,624	66.6
20	74.7	65.4	-84,367	63.3	-87,139	58.1	0	0.0	0	0.0	-87,139	58.4
21	72.3	65.0	-93,056	54.4	-93,912	51.5	0	0.0	0	0.0	-93,912	51.5
22	69.7	63.7	-99,761	48.3	-97,801	46.3	0	0.0	0	0.0	-97,801	46.3
23	67.1	62.0	-7,130	0.0	-8,268	0.0	0	0.0	0	0.0	-8,268	0.0
24	64.7	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0



BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

Day	Hour	QADB	QAWB	----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
				Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
	1	73.3	68.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	71.3	67.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	3	69.6	66.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	4	68.1	64.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	5	67.0	64.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	6	66.4	63.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	7	66.1	63.9	-47,068	70.1	-19,707	72.4	-53,562	63.7	0	100.6	0	104.5
	8	66.8	63.8	-108,506	48.4	-99,644	41.3	-116,989	39.3	0	74.0	0	83.1
	9	68.6	63.8	-102,217	61.3	-96,854	50.6	-112,218	46.4	-40,076	54.3	-15,518	56.9
	10	71.3	64.6	-58,107	67.3	-87,028	57.5	-98,893	54.1	-43,247	60.0	-40,823	62.3
	11	74.7	66.3	-46,904	71.9	-77,189	61.0	-85,761	59.4	-74,646	63.9	-36,125	65.7
	12	78.4	68.1	-40,189	76.0	-61,804	65.1	-65,533	64.5	-65,522	67.8	-60,145	69.2
	13	81.8	69.9	-31,404	79.8	-51,244	69.5	-54,422	69.0	-54,418	71.2	-51,232	72.4
	14	84.5	70.9	-26,828	83.5	-43,707	74.9	-46,415	74.5	-46,415	75.9	-43,706	76.9
	15	86.3	71.8	-27,263	87.6	-43,411	78.6	0	0.0	0	0.0	-43,411	80.5
	16	87.0	71.6	-25,488	90.7	-42,139	80.4	0	0.0	0	0.0	-42,139	81.9
	17	86.7	72.0	-19,186	92.8	-36,394	82.4	0	0.0	0	0.0	-36,394	83.6
	18	86.1	71.7	-19,776	91.9	-35,034	82.2	0	0.0	0	0.0	-35,034	83.3
	19	85.0	71.9	-54,338	82.2	-66,100	74.8	0	0.0	0	0.0	-66,100	76.2
	20	83.5	72.5	-70,363	72.0	-76,983	67.8	0	0.0	0	0.0	-76,983	70.1
	21	81.8	72.9	-88,545	62.3	-90,042	61.7	0	0.0	0	0.0	-90,042	64.4
	22	79.8	72.1	-93,358	56.0	-93,413	57.3	0	0.0	0	0.0	-93,413	57.9
	23	77.6	71.2	-6,662	0.0	-3,756	0.0	0	0.0	0	0.0	-3,770	0.0
	24	75.5	69.9	-2,312	0.0	-2,305	0.0	0	0.0	0	0.0	-2,305	0.0

Day	Hour	QADB	QAWB	----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
				Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
	1	78.8	73.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	2	76.6	71.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	3	74.6	70.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	4	73.0	69.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	5	71.7	68.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	6	71.0	67.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	7	70.7	67.5	0	95.0	0	95.2	0	91.2	0	110.3	0	113.6
	8	71.2	67.0	-36,902	58.4	-34,362	50.9	-86,698	45.7	0	101.6	0	105.7
	9	72.7	66.6	-67,429	67.4	-84,104	56.2	-97,119	54.7	0	68.2	0	77.0
	10	75.0	66.9	-46,331	74.1	-68,390	63.6	-77,943	62.1	-7,711	67.5	0	70.3
	11	77.9	67.5	-37,683	78.9	-59,698	67.8	-64,079	64.7	-28,513	70.4	-15,896	72.8
	12	81.2	68.7	-31,924	82.2	-53,174	71.2	-56,905	69.0	-38,558	73.2	-24,535	75.2
	13	84.4	69.9	-23,195	84.6	-42,454	74.5	-45,631	73.3	-45,631	76.1	-23,790	77.7
	14	87.3	71.0	-17,751	88.3	-36,376	78.4	-39,084	77.8	-39,078	79.8	-36,378	81.0
	15	89.7	71.7	-18,350	91.8	-35,781	82.7	0	0.0	0	0.0	-35,775	85.2
	16	91.1	72.8	-16,527	95.5	-34,007	85.1	0	0.0	0	0.0	-34,007	87.3
	17	91.7	72.8	-10,375	97.7	-26,666	87.4	0	0.0	0	0.0	-26,666	89.3
	18	91.4	72.6	-8,618	96.8	-24,610	87.9	0	0.0	0	0.0	-24,610	89.6
	19	90.6	73.2	-41,736	88.3	-55,139	82.0	0	0.0	0	0.0	-55,139	83.6
	20	89.4	74.1	-59,204	77.9	-66,633	74.8	0	0.0	0	0.0	-66,633	77.6
	21	87.7	75.7	-79,127	68.2	-81,481	69.0	0	0.0	0	0.0	-81,481	72.0
	22	85.7	76.0	-91,068	61.9	-90,848	64.9	0	0.0	0	0.0	-90,848	67.6
	23	83.5	75.3	-4,780	0.0	-4,046	0.0	0	0.0	0	0.0	-4,046	0.0
	24	81.2	74.2	-2,862	0.0	-2,972	0.0	0	0.0	0	0.0	-2,972	0.0

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

July	----- Design -----				----- Weekday -----				----- Saturday-----				----- Sunday -----				----- Monday -----			
Hour	OADB	QAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	82.5	74.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	80.3	73.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	78.2	72.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	76.5	71.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	75.3	70.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	74.5	70.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	74.2	70.4	0	102.7	0	102.6	0	100.5	0	113.8	0	113.8	0	113.8	0	115.2	0	115.2	0	115.2
8	74.7	70.5	0	75.3	-2,470	68.2	-24,906	61.9	0	110.0	0	110.0	0	110.0	0	113.4	0	113.4	0	113.4
9	76.3	70.6	-35,260	72.3	-51,913	61.5	-94,557	60.0	0	95.0	0	95.0	0	95.0	0	101.8	0	101.8	0	101.8
10	78.6	70.9	-44,967	79.6	-65,240	68.9	-70,376	67.8	0	76.6	0	76.6	0	76.6	0	83.3	0	83.3	0	83.3
11	81.6	71.2	-35,094	84.7	-55,961	73.4	-60,355	72.5	0	77.4	0	77.4	0	77.4	0	80.2	0	80.2	0	80.2
12	84.9	71.9	-27,362	88.4	-47,587	76.6	-51,317	74.5	-21,418	79.5	-3,580	81.9	-3,580	81.9	-16,576	84.0	-16,576	84.0	-16,576	84.0
13	88.2	72.7	-18,549	90.8	-37,859	79.8	-41,036	78.5	-18,371	81.9	-13,628	87.5	-13,628	87.5	-21,133	91.6	-21,133	91.6	-21,133	91.6
14	91.2	73.2	-12,901	94.2	-30,634	84.1	-33,341	83.4	-33,344	85.8	-26,702	94.3	-26,702	94.3	-19,642	97.2	-19,642	97.2	-19,642	97.2
15	93.6	73.9	-13,397	97.5	-29,613	88.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
16	95.1	73.7	-11,554	100.9	-26,703	91.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
17	95.7	73.9	-6,132	103.2	-19,645	94.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
18	95.4	73.8	-5,999	102.0	-18,199	95.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
19	94.6	73.9	-38,437	92.7	-48,648	89.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
20	93.3	74.7	-55,336	82.3	-60,255	82.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
21	91.6	76.0	-75,866	73.4	-75,397	74.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
22	89.6	76.6	-87,844	65.8	-84,769	70.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
23	87.3	76.3	-4,400	0.0	-4,647	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
24	84.9	75.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

August	----- Design -----				----- Weekday -----				----- Saturday-----				----- Sunday -----				----- Monday -----			
Hour	OADB	QAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	82.5	75.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	80.3	74.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	78.4	73.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	76.8	72.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	75.6	71.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	74.9	70.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	74.6	71.0	0	105.3	0	104.5	0	102.4	0	113.6	0	113.6	0	113.6	0	115.2	0	115.2	0	115.2
8	75.1	71.3	-2,297	77.0	-15,708	66.3	-41,553	59.8	0	110.5	0	110.5	0	110.5	0	113.4	0	113.4	0	113.4
9	76.5	71.4	-42,131	72.4	-59,968	61.8	-96,658	60.3	0	93.1	0	93.1	0	93.1	0	99.7	0	99.7	0	99.7
10	78.8	71.6	-50,588	80.2	-69,770	69.3	-76,760	68.2	0	77.2	0	77.2	0	77.2	0	85.2	0	85.2	0	85.2
11	81.6	72.2	-40,124	86.7	-59,487	74.2	-63,877	73.3	-19,244	77.8	0	80.6	-19,244	77.8	0	80.6	-19,244	77.8	0	80.6
12	84.7	73.4	-32,128	91.0	-51,031	78.4	-54,761	76.1	-24,692	81.2	-20,914	83.6	-24,692	81.2	-20,914	83.6	-24,692	81.2	-20,914	83.6
13	87.9	74.2	-22,777	93.9	-41,374	82.1	-44,551	80.8	-30,971	84.3	-19,723	86.4	-30,971	84.3	-19,723	86.4	-30,971	84.3	-19,723	86.4
14	90.7	75.1	-18,352	97.9	-35,133	87.0	-37,841	86.5	-37,839	89.0	-17,745	90.8	-37,839	89.0	-17,745	90.8	-37,839	89.0	-17,745	90.8
15	92.9	75.6	-18,601	101.7	-34,159	92.0	0	0.0	0	0.0	-31,997	95.3	0	0.0	-31,997	95.3	0	0.0	-31,997	95.3
16	94.3	75.2	-16,645	104.1	-32,167	93.3	0	0.0	0	0.0	-32,163	96.2	0	0.0	-32,163	96.2	0	0.0	-32,163	96.2
17	94.8	74.9	-11,692	105.8	-24,726	96.5	0	0.0	0	0.0	-24,725	99.2	0	0.0	-24,725	99.2	0	0.0	-24,725	99.2
18	94.6	74.4	-13,231	103.6	-24,437	95.8	0	0.0	0	0.0	-24,437	98.1	0	0.0	-24,437	98.1	0	0.0	-24,437	98.1
19	93.8	74.6	-49,660	90.9	-56,791	87.7	0	0.0	0	0.0	-56,791	89.8	0	0.0	-56,791	89.8	0	0.0	-56,791	89.8
20	92.6	75.7	-64,102	81.6	-66,921	80.9	0	0.0	0	0.0	-66,921	83.5	0	0.0	-66,921	83.5	0	0.0	-66,921	83.5
21	91.0	77.2	-81,388	72.8	-80,550	74.9	0	0.0	0	0.0	-80,550	78.3	0	0.0	-80,550	78.3	0	0.0	-80,550	78.3
22	89.1	77.6	-90,785	66.0	-88,171	70.1	0	0.0	0	0.0	-88,171	73.4	0	0.0	-88,171	73.4	0	0.0	-88,171	73.4
23	87.0	77.3	-4,296	0.0	-4,453	0.0	0	0.0	0	0.0	-4,453	0.0	0	0.0	-4,453	0.0	0	0.0	-4,453	0.0
24	84.7	76.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

September			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	76.3	71.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	74.7	70.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	73.2	69.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	72.0	68.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	71.1	68.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	70.6	67.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	70.4	67.9	0	99.7	0	92.3	-27,833	80.8	0	108.9	0	112.0
8	70.9	68.6	-52,230	54.9	-73,120	47.2	-108,506	45.3	0	92.9	0	99.0
9	72.4	68.5	-91,407	66.3	-95,291	56.5	-108,506	54.6	-35,059	63.5	-10,468	70.6
10	74.7	69.3	-63,884	75.0	-86,585	64.7	-91,301	61.2	-44,120	67.6	-41,714	70.0
11	77.4	70.7	-53,738	81.6	-82,624	70.0	-85,622	67.1	-65,370	72.1	-37,549	74.2
12	80.4	71.5	-47,454	85.8	-65,919	72.9	-73,891	71.8	-68,464	75.5	-54,094	77.2
13	83.2	73.2	-38,282	89.7	-54,851	78.0	-58,025	77.5	-58,022	80.1	-54,843	81.6
14	85.4	73.8	-33,500	94.8	-47,830	84.4	-50,539	84.0	-50,537	85.8	-47,826	87.3
15	86.9	74.0	-34,111	98.8	-48,010	87.2	0	0.0	0	0.0	-48,009	89.8
16	87.4	73.6	-32,568	101.7	-47,241	88.3	0	0.0	0	0.0	-47,241	90.5
17	87.2	73.5	-28,157	103.9	-40,611	89.9	0	0.0	0	0.0	-40,611	91.8
18	86.7	73.0	-30,761	97.6	-41,257	87.5	0	0.0	0	0.0	-41,257	89.2
19	85.8	73.7	-68,612	82.3	-75,286	77.0	0	0.0	0	0.0	-75,286	78.9
20	84.6	74.6	-80,546	72.9	-84,230	71.0	0	0.0	0	0.0	-84,230	74.0
21	83.2	74.7	-90,253	65.1	-90,578	65.2	0	0.0	0	0.0	-90,578	68.3
22	81.5	74.9	-93,779	60.4	-93,618	61.7	0	0.0	0	0.0	-93,618	62.6
23	79.8	73.5	-4,889	0.0	-3,365	0.0	0	0.0	0	0.0	-3,365	0.0
24	78.0	72.7	-2,479	0.0	-2,426	0.0	0	0.0	0	0.0	-2,426	0.0

October			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	59.6	54.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	56.9	53.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	54.9	51.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4	53.6	50.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
5	53.1	50.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	53.6	50.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	54.9	52.2	-137,517	26.4	-151,146	23.6	-151,181	15.7	-2,760	0.0	0	0.0
8	56.9	54.3	-139,064	24.5	-146,488	18.2	-146,588	16.5	-96,747	48.4	-67,880	56.9
9	59.6	55.8	-125,030	41.8	-136,146	27.6	-136,146	23.5	-148,917	28.7	-131,533	30.7
10	62.8	55.9	-97,129	55.0	-113,457	40.4	-127,659	35.9	-134,211	39.9	-114,133	41.8
11	66.1	56.9	-87,143	62.8	-94,350	51.7	-118,906	49.9	-105,448	46.2	-101,644	48.0
12	69.5	58.5	-81,687	69.7	-85,624	57.5	-89,277	56.5	-96,746	51.1	-93,457	54.8
13	72.7	60.0	-74,879	76.2	-85,624	57.5	-89,277	56.5	-87,713	56.9	-84,921	59.7
14	75.4	61.2	-74,879	76.2	-78,434	63.5	-80,759	62.7	-80,197	62.9	-77,877	64.4
15	77.4	62.2	-54,765	83.2	-73,989	70.1	-75,961	69.3	-80,197	62.9	-77,877	64.4
16	78.7	62.7	-53,275	88.2	-72,194	72.6	0	0.0	-75,571	69.5	-73,601	70.1
17	79.2	62.8	-51,420	91.2	-69,003	75.5	0	0.0	0	0.0	-71,893	72.6
18	78.7	62.9	-47,486	90.3	-63,853	77.5	0	0.0	0	0.0	-68,770	75.4
19	77.4	63.4	-53,003	80.0	-62,250	73.2	0	0.0	0	0.0	-63,675	77.3
20	75.4	63.9	-83,487	66.1	-85,421	63.6	0	0.0	0	0.0	-60,383	73.1
21	72.7	63.2	-91,419	56.7	-89,706	57.6	0	0.0	0	0.0	-85,339	63.5
22	69.5	61.4	-101,580	48.9	-95,192	51.9	0	0.0	0	0.0	-89,644	57.5
23	66.1	59.5	-108,328	43.3	-98,994	46.8	0	0.0	0	0.0	-95,144	51.8
24	62.8	56.6	-11,300	0.0	-8,428	0.0	0	0.0	0	0.0	-98,957	46.7
			0	0.0	0	0.0	0	0.0	0	0.0	-8,428	0.0
											0	0.0

BUILDING COOL-HEAT DEMAND - ALTERNATIVE 2  
EXISTING CONDITIONS WITH STOP-START

November			----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----	
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	58.2	54.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
2	56.0	52.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
3	54.2	50.7	0	0.0	0	0.0	0	0.0	0	0.0	-5,246	0.0
4	52.8	49.5	0	0.0	0	0.0	0	0.0	-2,169	0.0	0	0.0
5	51.9	49.0	0	0.0	0	0.0	-5,225	0.0	-2,104	0.0	0	0.0
6	51.6	48.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
7	52.0	49.4	-152,764	19.9	-159,166	18.4	-153,498	13.1	-159,672	23.9	-143,198	26.0
8	53.2	50.6	-148,589	16.6	-156,493	15.7	-151,191	13.2	-159,377	20.3	-156,466	24.6
9	55.2	52.0	-138,268	23.3	-147,817	21.4	-146,734	17.4	-147,817	21.5	-131,369	30.4
10	57.6	53.3	-126,268	44.0	-130,429	24.5	-144,246	22.2	-128,228	33.4	-111,023	38.2
11	60.4	53.9	-95,627	55.8	-104,265	38.1	-134,024	33.0	-107,091	41.2	-103,825	42.2
12	63.3	55.2	-86,535	61.5	-96,241	46.5	-99,735	44.5	-98,664	45.7	-95,895	46.6
13	66.1	56.5	-78,051	67.6	-86,746	51.6	-89,159	50.7	-88,825	50.9	-86,479	51.6
14	68.5	57.8	-73,822	73.9	-79,578	56.4	-81,617	55.7	-81,361	55.8	-79,372	56.4
15	70.4	58.7	-71,661	78.9	-76,093	60.3	0	0.0	0	0.0	-75,933	60.3
16	71.6	59.4	-68,171	81.4	-73,023	63.8	0	0.0	0	0.0	-72,900	63.7
17	72.1	59.5	-63,476	80.4	-68,290	65.1	0	0.0	0	0.0	-68,194	65.0
18	71.8	60.2	-64,518	68.7	-67,012	60.8	0	0.0	0	0.0	-66,938	60.7
19	70.9	61.4	-92,282	56.5	-90,115	52.3	0	0.0	0	0.0	-90,058	52.2
20	69.5	61.8	-100,290	49.1	-94,285	48.2	0	0.0	0	0.0	-94,240	48.1
21	67.6	61.6	-109,213	42.6	-101,663	43.9	0	0.0	0	0.0	-101,629	43.8
22	65.5	60.0	-114,918	37.6	-106,849	39.8	0	0.0	0	0.0	-106,822	39.6
23	63.1	58.5	-12,237	0.0	-9,333	0.0	0	0.0	0	0.0	-9,333	0.0
24	60.6	55.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

December		----- Design -----		----- Weekday -----		----- Saturday-----		----- Sunday -----		----- Monday -----		
Hour	OADB	OAWB	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton	Htg Btuh	Clg Ton
1	48.2	44.6	-13,228	0.0	-2,045	0.0	-10,161	0.0	-14,837	0.0	-14,926	0.0
2	46.1	42.8	-24,262	0.0	-16,708	0.0	-22,041	0.0	-24,772	0.0	-19,772	0.0
3	44.2	41.1	-29,868	0.0	-25,219	0.0	-31,168	0.0	-33,370	0.0	-27,706	0.0
4	42.6	39.7	-34,735	0.0	-32,766	0.0	-38,898	0.0	-40,669	0.0	-34,735	0.0
5	41.4	38.7	-40,389	0.0	-38,555	0.0	-44,613	0.0	-47,204	0.0	-42,520	0.0
6	40.7	37.8	0	0.0	0	0.0	0	0.0	-2,431	0.0	0	0.0
7	40.4	37.7	-233,063	10.8	-284,019	10.2	-357,083	9.0	-237,716	8.8	-218,437	9.6
8	41.1	38.2	-187,908	11.0	-236,114	10.2	-260,176	9.3	-259,429	9.1	-218,621	9.7
9	43.1	40.1	-148,492	12.3	-151,152	11.4	-148,292	10.5	-148,277	10.4	-148,532	14.4
10	46.1	42.3	-133,133	14.7	-122,193	12.5	-147,024	11.9	-146,983	11.7	-128,032	16.7
11	49.8	44.5	-113,897	24.7	-112,745	16.4	-123,065	13.3	-127,365	13.6	-110,616	18.8
12	53.7	46.6	-103,590	39.6	-113,048	21.5	-112,400	14.5	-112,345	20.7	-111,039	21.2
13	57.4	49.0	-93,376	54.0	-102,421	27.9	-104,828	26.6	-104,834	26.5	-102,614	27.6
14	60.4	50.9	-86,812	60.2	-94,629	40.0	-96,668	38.4	-96,672	38.4	-94,781	40.2
15	62.4	52.0	-83,999	64.7	-90,306	48.8	0	0.0	0	0.0	-90,423	48.6
16	63.0	52.1	-81,201	68.2	-86,313	52.0	-2,677	0.0	-2,677	0.0	-86,404	51.8
17	62.8	51.6	-77,908	67.8	-81,353	53.7	0	0.0	0	0.0	-81,423	53.5
18	62.1	51.6	-80,338	57.2	-80,837	49.0	0	0.0	0	0.0	-80,891	48.8
19	60.9	51.8	-108,426	44.9	-105,275	40.0	0	0.0	0	0.0	-105,317	39.8
20	59.3	52.1	-116,889	37.6	-110,682	36.3	0	0.0	0	0.0	-110,715	36.0
21	57.4	51.8	-125,713	31.2	-118,247	31.8	0	0.0	0	0.0	-118,273	31.6
22	55.2	50.7	-131,436	26.1	-123,444	28.0	-6,133	0.0	-6,133	0.0	-123,464	27.8
23	52.9	48.9	-46,187	0.0	-2,348	0.0	0	0.0	0	0.0	-2,348	0.0
24	50.5	46.7	-8,361	0.0	-3,285	0.0	0	0.0	0	0.0	-3,285	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 GL)	GAS DMND On Peak (Thrm/hr)
Jan	58,679	194	769	35	6
Feb	50,416	192	692	30	5
March	69,034	208	542	64	2
April	71,759	218	397	82	2
May	81,052	229	306	105	1
June	82,624	235	226	115	1
July	84,565	242	169	125	1
Aug	89,972	246	217	132	1
Sept	79,775	240	290	108	1
Oct	73,049	221	486	76	2
Nov	64,568	210	509	53	2
Dec	56,222	197	699	31	4
Total	861,716	246	5,302	956	6

Building Energy Consumption = 97,397 (Btu/Sq Ft/Year)  
Source Energy Consumption = 263,246 (Btu/Sq Ft/Year)

Floor Area = 35,640 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Monthly Consumption												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	31114	28120	32183	29938	31648	31007	30579	32183	29938	31648	29938	30579	368,874
	PK	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTW20	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1131L	WTR-CLD COND COMP W-EVAP COND >30 TONS												
	ELEC	7657	6629	13908	17844	22738	24572	26442	28097	23323	16356	11930	6832	206,328
	PK	49.6	49.5	58.3	64.6	76.5	82.6	85.5	85.9	81.5	66.3	59.0	49.3	85.9
1	EQ5105	COOLING TOWER												
	ELEC	4430	2010	7104	8187	8678	8514	8351	8842	8187	8167	7737	4081	84,287
	PK	20.5	16.4	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
1	EQ5105	COOLING TOWER												
	WATER	33	28	62	80	104	114	124	131	106	75	52	29	939
	PK	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4
1	EQ5302	CONTROLS												
	ELEC	28	23	41	40	42	42	41	43	40	40	38	27	445
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2	EQ1100S	AIR-CLD RECIP 25-45 TONS												
	ELEC	9750	8693	11021	11050	12897	13625	14429	15581	13447	11877	10472	9604	142,446
	PK	26.2	26.4	28.5	31.5	35.2	38.0	41.1	41.8	38.2	32.5	28.9	26.7	41.8
	EQ5200	CONDENSER FANS												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

	ELEC	439	357	701	950	1157	1271	1458	1512	1299	960	679	429	11,212
	PK	1.5	1.4	2.7	3.1	3.3	3.5	4.9	4.9	3.7	3.2	2.7	1.6	4.9
2	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	1241	1122	1289	1193	1265	1241	1217	1289	1193	1265	1193	1217	14,723
	PK	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
2	EQ5303	CONTROLS												
	ELEC	125	113	130	120	127	125	122	130	120	127	120	122	1,481
	PK	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
1	EQ2002	GAS FIRE TUBE STEAM												
	GAS	769	692	542	397	306	226	169	217	290	486	509	699	5,302
	PK	6.3	5.4	2.1	1.5	1.4	1.2	1.1	1.2	1.3	1.8	2.0	4.3	6.3
1	EQ5020	HEAT WATER CIRC. PUMP C.V.												
	ELEC	3147	2704	2148	1969	2018	1800	1556	1854	1800	2108	1989	2689	25,781
	PK	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
1	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	413	355	282	259	265	236	204	244	236	277	261	353	3,386
	PK	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
1	EQ5307	BOILER CONTROLS												
	ELEC	317	272	216	198	203	181	157	186	181	212	200	271	2,593
	PK	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	EQ5061	CONDENSATE RETURN PUMP												
	ELEC	19	17	13	12	12	11	10	11	11	13	12	17	159
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5406	MAKE-UP WATER												
	WATER	2	2	1	1	1	1	1	1	1	1	1	2	18
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 2

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value        246.4    (kW)  
Yearly Time of Peak 16 (hr)    8 (mo)

Hour 16    Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
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Cooling Equipment

1	EQ1131L	WTR-CLD COND COMP W-EVAP COND >30 TONS	101.7	41.29
2	EQ1100S	AIR-CLD RECIP 25-45 TONS	49.4	20.05

Sub Total			151.1	61.33
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Heating Equipment

1	EQ2002	GAS FIRE TUBE STEAM	6.2	2.50
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Sub Total			6.2	2.50
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Sub Total			0.0	0.00
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Sub Total			0.0	0.00
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Miscellaneous

Lights			89.1	36.17
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Base Utilities			0.0	0.00
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Misc Equipment			0.0	0.00
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Sub Total			89.1	36.17
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Grand Total			246.4	100.00
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[illegible]

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0407 - ECO IV. C. 1) - ADD STOP/START FUNCTION TO HVAC EQUIPMENT  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$2,003	
B. SIOH	\$110	
C. DESIGN COST	\$120	
D. TOTAL COST (1A+1B+1C)	\$2,233	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$2,233

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	618.66	\$6,527	11.77	\$76,821
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	681.08	\$2,254	15.34	\$34,582
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. OTHER			\$0	11.12	\$0
M. DEMAND SAVINGS			\$0	11.12	\$0
N. TOTAL		1299.74	\$8,781		\$111,403

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	(\$45)
1. DISCOUNT FACTOR (TABLE A)	11.1
2. DISCOUNTED SAVINGS/COST (3A X 3A1)	(\$500)

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) (\$500)

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 0.3 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$110,904

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 49.66

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 34.9%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 407

ECO NO: VII. C, D & IX A, B, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings: 12,315 KWH/yr  
Demand Savings: 53.2 KW/yr  
Gas Savings: N/A MCF/yr  
Cost Savings: \$ 1,012 /yr  
Implementation Cost: \$ 4,557.00  
Simple Payback: 4.5 Years  
Savings to Investment:  
Ratio (SIR): 1.97

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current lighting levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
15	Decorative chandelier	None.
16	Decorative wall sconce	None.
26	Incandescent downlights	Retrofit with compact fluor. lamps.
90	2-Lamp, 4' Fluor.	Remove 5 fixtures and retrofit remaining with T8 lamps and electronic ballasts.
3	Incand. Exit Light	Replace with LED exit fixture.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= (15.64 \text{ KW} - 11.21 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (15.64 \text{ KW} - 11.21 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$354.40/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD0407A	48190	11388	119914	8823	5054	2.786	10.187	4087	29014	86812	2135	6388
*BLD0407B	53244	0	131302	9661	0	0.000	0.000	0	26104	105198	1921	7741

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD0407A	POST RETROFIT CONDITIONS
BLD0407B	EXISTING CONDITIONS

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Whole Building Summary Report

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0407\BLD0407A.WBR  
 Date: 10/17/1993

Lighting Annual : 48190 kWh  
 Lighting Capacity : 11.207 kW  
 Annual Cooling Effect : 67663 kWh  
 Annual Heating Effect : 13901 kWh  
 Total Surveyed Floor Area: 8180 SqFt  
 Percent Survey Completed : 818000 %  
 Lighting Power Density : 1.370 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4087	36476	29014	52721	-2385	119914
AVLCC \$	301	2684	2135	3879	-176	8823

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0407\BLD0407A.LLR

Date: 10/17/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	81.0	6.2	45.9	34.74	4-food prepare	2-dining
Measured	75.3	4.6	36.4	25.73	6-kitchen	2-dining
Required	75.0	5.0	40.4	31.40	4-food prepare	1-bar

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	20.2	-1.3	5.5	7.55	5-skullery	2-dining
Meas - Req.	9.9	-21.3	-4.1	11.15	1-bar	4-food prepare



Lighting System Survey Summary  
One Page for Each Defined System

ject: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0407\BLD0407A.LSR  
Date: 10/17/1993

System Number: 1 Descrip: decorative chandelier

Rooms Served: 2  
Floor Area: 4400 SqFt  
Possible kW: 4.800  
Working kW: 4.800  
Capacity kW: 4.800  
Lighting: 20640 Annual kWh  
Heating: 5954 Annual kWh  
Cooling: 28999 Annual kWh  
Op Hours/Year: 4300 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 2.8 Months  
Power Density: 1.091 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	15	120	0.0
Working	15	120	0.0
Capacity	15	120	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	15623	20600	22598	-1022	58016
AVLCC \$	1150	1516	1663	-75	4269

System Number: 2 Descrip: decorative wall sconce

Rooms Served: 2  
Floor Area: 4400 SqFt  
Possible kW: 0.640  
Working kW: 0.640  
Capacity kW: 0.640  
Lighting: 2752 Annual kWh  
Heating: 794 Annual kWh  
Cooling: 3867 Annual kWh  
Op Hours/Year: 4300 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 2.8 Months  
Power Density: 0.145 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	16	16	0.0
Working	16	16	0.0
Capacity	16	16	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2083	2747	3013	-136	7735
AVLCC \$	153	202	222	-10	569

System Number: 3      Descrip: incand down light

Rooms Served: 2  
 Floor Area: 4594 SqFt  
 Possible kW: 0.429  
 Working kW: 0.429  
 Capacity kW: 0.429  
 Lighting: 1845 Annual kWh  
 Heating: 532 Annual kWh  
 Cooling: 2592 Annual kWh  
 Op Hours/Year: 4300 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 46.0 Months  
 Power Density: 0.093 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	26	26	26.0
Working	26	26	26.0
Capacity	26	26	26.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1396	2531	2020	-91	6211
AVLCC \$	103	186	149	-7	457

System Number: 4      Descrip: 2x4 lay-in

Rooms Served: 1  
 Floor Area: 616 SqFt  
 Possible kW: 0.314  
 Working kW: 0.314  
 Capacity kW: 0.314  
 Lighting: 1350 Annual kWh  
 Heating: 389 Annual kWh  
 Cooling: 1853 Annual kWh  
 Op Hours/Year: 4300 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.0 Months  
 Power Density: 0.510 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	5	10	5.0
Working	5	10	5.0
Capacity	5	10	5.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1022	185	1437	-67	2782
AVLCC \$	75	14	106	-5	205

System Number: 5      Descrip: fluor wrap

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Rooms Served: 3  
 Floor Area: 3164 SqFt  
 Possible kW: 5.024  
 Working kW: 5.024  
 Capacity kW: 5.024  
 Lighting: 21603 Annual kWh  
 Heating: 6232 Annual kWh  
 Cooling: 30352 Annual kWh  
 Op Hours/Year: 4300 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.0 Months  
 Power Density: 1.588 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	80	160	80.0
Working	80	160	80.0
Capacity	80	160	80.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	16352	2953	23653	-1069	45169
AVLCC \$	1203	217	1740	-79	3324

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Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\J08\911099\12\FELECT\FLEX\OUT\0407\BLD0407A.RRR  
 Date: 10/17/1993

Room Name	Floor	#	Total Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt SYSTEM2 sqft Name	Work Watts	Pot. Watts	Watt SYSTEM3 sqft Name	Work Watts	Pot. Watts	Watt Work sqft	Pot. Watts	Watt Meas. FootC	Calc. Req. FootC			
1-bar	1	1	2200	42 incand dow	264	264	0.12 decorative	960	960	0.44 decorative	240	240	0.11	1464	1464	0.67	14.9	7.3	5.0
2-dining	1	1	2200	40 decorative	3840	3840	1.75 decorative	400	400	0.18				4240	4240	1.93	4.6	6.2	7.5
3-serv lin	1	1	616	10 2x4 lay-in	314	314	0.51							314	314	0.51	32.1	33.5	30.0
4-food pre	1	1	420	2 fluor wrap	816	816	1.94							816	816	1.94	53.7	81.0	75.0
5-skullery	1	1	350	2 fluor wrap	628	628	1.79							628	628	1.79	37.5	70.2	50.0
6-kitchen	1	1	2394	10 fluor wrap	3580	3580	1.50 incand dow	165	165	0.07				3745	3745	1.56	75.3	77.4	75.0

Total Rooms : 6  
 Total Area Sqft : 8180  
 Total People : 106  
 Total Working kW : 11.207  
 Total Potential kW : 11.207  
 Power Density W/sqft : 1.370

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0407\BLD0407B.WBR

Date: 10/16/1993

Lighting Annual : 53244 kWh  
 Lighting Capacity : 15.640 kW  
 Annual Cooling Effect : 74923 kWh  
 Annual Heating Effect : 15359 kWh  
 Total Surveyed Floor Area: 8180 SqFt  
 Percent Survey Completed : 818000 %  
 Lighting Power Density : 1.912 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	43953	26104	63880	-2636	131302
AVLCC \$	0	3234	1921	4700	-194	9661

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\0407\BLD0407B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: decorative chandelier

Rooms Served: 2  
Floor Area: 4400 SqFt  
Possible kW: 4.800  
Working kW: 4.640  
Capacity kW: 4.800  
Lighting: 16320 Annual kWh  
Heating: 4708 Annual kWh  
Cooling: 22949 Annual kWh  
Op Hours/Year: 3400 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 3.5 Months  
Power Density: 1.055 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	15	120	0.0
Working	15	116	0.0
Capacity	15	120	0.0
Disconnected	0	0	0.0
Broken/Burned	0	4	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	13479	16288	19585	-808	48544
AVLCC \$	992	1198	1441	-59	3572

System Number: 2      Descrip: decorative wall sconce

Rooms Served: 2  
Floor Area: 4400 SqFt  
Possible kW: 0.640  
Working kW: 0.520  
Capacity kW: 0.640  
Lighting: 2176 Annual kWh  
Heating: 628 Annual kWh  
Cooling: 3060 Annual kWh  
Op Hours/Year: 3400 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 3.5 Months  
Power Density: 0.118 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	16	16	0.0
Working	15	13	0.0
Capacity	16	16	0.0
Disconnected	0	0	0.0
Broken/Burned	1	2	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1797	2172	2611	-108	6473
AVLCC \$	132	160	192	-8	476

System Number: 3      Descrip: incand down light

Rooms Served: 2  
 Floor Area: 4594 SqFt  
 Possible kW: 1.560  
 Working kW: 1.080  
 Capacity kW: 1.560  
 Lighting: 5304 Annual kWh  
 Heating: 1530 Annual kWh  
 Cooling: 7459 Annual kWh  
 Op Hours/Year: 3400 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 3.5 Months  
 Power Density: 0.235 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	26	26	0.0
Working	22	18	0.0
Capacity	26	26	0.0
Disconnected	0	0	0.0
Broken/Burned	4	4	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4381	3433	6365	-263	13916
AVLCC \$	322	253	468	-19	1024

System Number: 5      Descrip: 2x4 lay-in

Rooms Served: 1  
 Floor Area: 616 SqFt  
 Possible kW: 0.960  
 Working kW: 0.768  
 Capacity kW: 0.960  
 Lighting: 3332 Annual kWh  
 Heating: 961 Annual kWh  
 Cooling: 4736 Annual kWh  
 Op Hours/Year: 3471 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 93.8 Months  
 Power Density: 1.247 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	20	10.0
Working	8	16	8.0
Capacity	10	20	10.0
Disconnected	0	0	0.0
Broken/Burned	2	0	2.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2730	495	3983	-165	7042
AVLCC \$	201	36	293	-12	518

System Number: 6      Descrip: fluor wrap

=====

Rooms Served: 3  
Floor Area: 3164 SqFt  
Possible kW: 7.680  
Working kW: 7.488  
Capacity kW: 7.680  
Lighting: 26112 Annual kWh  
Heating: 7532 Annual kWh  
Cooling: 36719 Annual kWh  
Op Hours/Year: 3400 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 115.9 Months  
Power Density: 2.367 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	80	160	80.0
Working	80	156	78.0
Capacity	80	160	80.0
Disconnected	0	0	0.0
Broken/Burned	0	4	2.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	21566	3717	31336	-1293	55327
AVLCC \$	1587	274	2306	-95	4071



# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 0407 - ECO VII. C., D. & IX A., B., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$4,087	
B. SIOH	\$225	
C. DESIGN COST	\$245	
D. TOTAL COST (1A+1B+1C)	\$4,557	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$4,557

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	17.25	\$182	11.77	\$2,142
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG			\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	24.78	\$261	11.12	\$2,907
M. DEMAND SAVINGS			\$354	11.12	\$3,941
N. TOTAL		42.03	\$798		\$8,990

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$214	
1. DISCOUNT FACTOR (TABLE A)		11.1
2. DISCOUNTED SAVINGS/COST (3A X 3A1)		\$2,375

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

	ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a.	N/A	\$0	1	0.96	\$0
b.	N/A	\$0	2	0.92	\$0
c.	N/A	\$0	3	0.89	\$0
d.	N/A	\$0	4	0.85	\$0
e.	N/A	\$0	5	0.82	\$0
f.	N/A	\$0	6	0.79	\$0
g.	N/A	\$0	7	0.76	\$0
h.	N/A	\$0	8	0.73	\$0
i.	N/A	\$0	9	0.7	\$0
j.	N/A	\$0	10	0.68	\$0
k.	N/A	\$0	11	0.65	\$0
l.	N/A	\$0	12	0.62	\$0
m.	N/A	\$0	13	0.6	\$0
n.	N/A	\$0	14	0.58	\$0
o.	N/A	\$0	15	0.56	\$0
p.	TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$2,375

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 4.5 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$11,365

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 2.49

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 10.5%

## ENERGY CONSERVATION ANALYSIS

### BUILDING 1350 - ACADEMY DINING

Building 1350 is a three story building consisting of approximately 180,000 square feet. This facility contains a full service kitchen and a large dining area which consists of 8,430 square feet.

The operating hours are from 4:30 am to 9:00 pm, 5 days per week.

The lighting system is primarily fluorescent.

The mechanical system consists of multizone air handling units served by a water cooled centrifugal chiller. Heating is provided to the units by two gas fire boilers. The chiller and boilers are located in a remote central mechanical room.

Hot water for the kitchen is provided by two gas fired boilers located in a nearby mechanical room. Dishwashing is accomplished by utilizing an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 1350:

1. IV. D. 1) - Replace chiller with higher EF/CFC free chiller
2. VII. D - Reduce indoor/outdoor lighting to AEI levels
3. IX. C - Replace standard lamps with energy saving lamps
4. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING 1350

ECO NO: IV.D.1)

ECO NAME: Replace chiller with higher efficiency, CFC free chiller.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>126,750</u>	KWH/yr
Demand Savings:	<u>528</u>	KW/yr
Gas Savings:	<u>0</u>	MCF/yr
Cost Savings:	<u>\$ 8,084</u>	/yr
Implementation Cost:	<u>\$ 231,987.00</u>	
Simple Payback:	<u>11.8</u>	Years
Savings to Investment: Ratio (SIR):	<u>1.05</u>	

#### ECO DESCRIPTION:

Currently, a 438 ton centrifugal chiller is utilized for Building 1350. This chiller was installed in 1986 and operates at an efficiency of .715 KW/ton. Also, this chiller contains refrigerant R-11. This ECO analyzes replacement of the existing chiller with a CFC free chiller with an operating efficiency of .534 KW/ton. This ECO accounts for the interdependencies related to the operating controls and the proposed lighting retrofit.

#### COST SAVINGS CALCULATIONS:

(Refer to following Trace Output)

*KWH Savings* =  $(2,940,848 \text{ KWH/yr} - 2,814,098 \text{ KWH}) \times \$0.036/\text{KWH} = \$4,563/\text{yr}$   
*Demand Savings* =  $(569 - 525 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (569 \text{ KW} - 525 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW}$   
= \$3,520/yr  
*Total Savings* = \$8,084/yr

**IMPLEMENTATION COSTS:**

(Refer to following Cost Estimate)

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

LINE #	
1	JOB - 1
2	01/FORT SAM HOUSTON EEAP
3	01/SAN ANTONIO
4	01/FWD-COE
5	01/SCOTT CLARK
6	01/HVAC IMPROVEMENTS
7	08/SANANTON
8	09/JAN/DEC
9	10/CLTD-CLF
10	11/JAN/DEC
11	LOAD - 1
12	19/1/ENERGY CONSERVATION SIMULATION
13	20/1/1/FIRST FLOOR/15/230//4//14
14	20/2/2/FIRST FLOOR/15/230//4//14
15	20/3/3/FIRST FLOOR/15/230//4//14
16	20/4/4/FIRST FLOOR/15/230//4//14
17	20/5/5/FIRST FLOOR/215/215//4//14
18	20/6/6/SECOND FLOOR/15/230//4//14
19	20/7/7/SECOND FLOOR/15/230//4//14
20	20/8/8/SECOND FLOOR/15/230//4//14
21	20/9/9/SECOND FLOOR/15/230//4//14
22	20/10/10/SECOND FLOOR/215/215//4//14
23	20/11/11/THIRD FLOOR/15/230//4//14
24	20/12/12/THIRD FLOOR/15/230//4//14
25	20/13/13/THIRD FLOOR/15/230//4//14
26	20/14/14/THIRD FLOOR/15/230//4//14
27	20/15/15/THIRD FLOOR/215/215//4//14
28	21/M/78/50/78//70/70
29	22/11/1/YES///.07
30	22/12/1/YES///.07
31	22/13/1/YES///.07
	22/14/1/YES///.07
	22/15/1/YES///.07
34	24/1/1/245/14/.15/68
35	24/2/1/245/14/.15/68/90
36	24/3/1/245/14/.15/68/180
37	24/4/1/245/14/.15/68/270
38	24/6/1/245/14/.15/68
39	24/7/1/245/14/.15/68/90
40	24/8/1/245/14/.15/68/180
41	24/9/1/245/14/.15/68/270
42	24/11/1/245/14/.15/68
43	24/12/1/245/14/.15/68/90
44	24/13/1/245/14/.15/68/180
45	24/14/1/245/14/.15/68/270
46	25/M/1///15/1.07/.5
47	26/M/1350PLP/1350LT
48	27/M/125/SF-PERS/255/255/2.5/WATT-SF///30
49	28/M/1//1.5/WATT-SF/1350LT
50	29/M/15/CFM-P/15/CFM-P
51	30/M/.75/CFM-SF
52	SYSTEM - 1
53	39/1/EXISTING COND, 24 HR OPERATION
54	40/1/VTCV
55	41/1/1/15
56	42/1/2.5/2.5
57	43/1/54/62
58	44/1/NONE

LINE # -----

59 45/1/AVAIL

60 EQUIPMENT - 1

61 60/1/1/PKPLANT/1/1

62 61/1/1

63 62/1/EQ1001S//438/TONS/.715/KW-TON

64 63/1/50/HP/25/HP

65 64/1//NO/NO/NONE

66 65/1/1//1/1

67 66/1/1

68 67/1/EQ2001/1/15/HP

69 69/1/EQ4003/EQ4003

70 70/1/150/150

71 SYSTEM - 2

72 39/2/EXISTING COND, STOP-START ADDED

73 40/1/VTCV

74 41/1/1/15

75 42/1/2.5/2.5

76 43/1/54/62

77 44/1/NONE

78 45/1/1350EX

79 46/1///START/STOP

80 EQUIPMENT - 2

81 60/1/1/PKPLANT/1/1

82 61/1/1

83 62/1/EQ1001S//438/TONS/.715/KW-TON

84 63/1/50/HP/25/HP

85 64/1//NO/NO/NONE

86 65/1/1//1/1

87 66/1/1

88 67/1/EQ2001/1/15/HP

69/1/EQ4003/EQ4003

70/1/150/150

91 SYSTEM - 3

92 39/3/STOP-START WITH NEW CHILLER

93 40/1/VTCV

94 41/1/1/15

95 42/1/2.5/2.5

96 43/1/54/62

97 44/1/NONE

98 45/1/1350EX

99 46/1///START/STOP

100 EQUIPMENT - 3

101 60/1/1/PKPLANT/1/1

102 61/1/1

103 62/1/EQ1001S//438/TONS/.534/KW-TON

104 63/1/50/HP/25/HP

105 64/1//NO/NO/NONE

106 65/1/1//1/1

107 66/1/1

108 67/1/EQ2001/1/15/HP

109 69/1/EQ4003/EQ4003

110 70/1/150/150

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TRACE 600 ANALYSIS \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/Lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 12:31:17 4/17/94  
Dataset Name: 1350E .TM



AIRFLOW - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	21,609	146,258	146,258	146,258	21,609	0	0
Totals		21,609	146,258	146,258	146,258	21,609	0	0

CAPACITY - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

		Cooling					Heating					
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
1	VTCV	371.9	0.0	0.0	371.9	-1,571,391	0	0	0	0	0	-1,571,391
Totals		371.9	0.0	0.0	371.9	-1,571,391	0	0	0	0	0	-1,571,391

The building peaked at hour 14 month 8 with a capacity of 370.3 tons

ENGINEERING CHECKS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	14.77	0.81	393.2	484.2	24.79	0.81	-8.73	180,075

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==>						Mo/Hr: 7/16			Mo/Hr: 13/ 1		
Outside Air ==>						OADB: 96			OADB: 30		
	Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct	Space Peak	Coil Peak	Perct
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot	Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Envelope Loads											
Skylite Solr	0	0		0	0.00		0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00		0	0.00	0	0	0.00
Roof Cond	0	219,558		219,558	4.92		0	0.00	0	-163,538	10.41
Glass Solar	162,068	0		162,068	3.63		221,235	8.70	0	0	0.00
Glass Cond	93,257	0		93,257	2.09		82,137	3.23	-290,011	-290,011	18.46
Wall Cond	56,439	25,002		81,441	1.82		60,010	2.36	-139,356	-208,013	13.24
Partition	0			0	0.00		0	0.00	0	0	0.00
Exposed Floor	0			0	0.00		0	0.00	0	0	0.00
Infiltration	0			0	0.00		0	0.00	-1	-1	0.00
Sub Total==>	311,764	244,559		556,324	12.46		363,382	14.29	-429,368	-661,563	42.10
Internal Loads											
Lights	445,392	190,882		636,274	14.26		459,178	18.06	0	0	0.00
People	690,834			690,834	15.48		333,615	13.12	0	0	0.00
Misc	832,176	0	0	832,176	18.65		849,625	33.42	0	0	0.00
Sub Total==>	1,968,402	190,882	0	2,159,284	48.38		1,642,417	64.60	0	0	0.00
Ceiling Load	115,638	-115,638		0	0.00		141,308	5.56	-61,543	0	0.00
Outside Air	0	0	0	1,139,484	25.53		0	0.00	0	-935,041	59.50
Sup. Fan Heat				260,013	5.83			0.00		0	0.00
Ret. Fan Heat		0		0	0.00			0.00		0	0.00
Duct Heat Pkup		0		0	0.00			0.00		0	0.00
OV/UNDR Sizing	395,512			395,512	8.86		395,512	15.56	0	0	0.00
Must Heat		-47,376	0	-47,376	-1.06			0.00		25,213	-1.60
Main Bypass		0	0	0	0.00			0.00		0	0.00
Grand Total==>	2,791,317	272,427	0	4,463,242	100.00		2,542,620	100.00	-490,911	-1,571,391	100.00

-----COOLING COIL SELECTION-----											-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR				Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor	180,075	
Main Clg	371.9	4,463.2	3,362.7	146,258	82.3	68.0	83.2	60.3	58.7	73.6	Part	0	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Roof	60,025	0 0
Totals	371.9	4,463.2									Wall	41,160	6,174 15

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----		-----TEMPERATURES (F)-----		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating		Clg % OA	14.8	Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F					Clg Cfm/Sqft	0.81	SADB	61.9	73.1
Main Htg	-1,571.4	146,258	63.2	73.1	Vent	21,609	21,609	Clg Cfm/Ton	393.23	Plenum	80.0	68.9
Aux Htg	0.0	0	0.0	0.0	Infil	0	0	Clg Sqft/Ton	484.15	Return	80.0	68.9
Preheat	-0.0	146,258	63.2	60.3	Supply	146,258	146,258	Clg Btuh/Sqft	24.79	Ret/OA	82.3	63.2
Reheat	0.0	0	0.0	0.0	Mincfm	0	0	No. People	1,441	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Return	146,258	146,258	Htg % OA	14.8	Fn MtrTD	0.4	0.4
Opt Vent	0.0	0	0.0	0.0	Exhaust	21,609	21,609	Htg Cfm/Sqft	0.81	Fn BldTD	0.3	0.3
Total	-1,571.4				Rm Exh	0	0	Htg Btuh/Sqft	-8.73	Fn Frict	0.9	0.9
					Auxil	0	0					

MAIN SYSTEM COOLING - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

PEAK COOLING LOADS  
(Main System)

Room Number	Description	Peak Time Mo/Hr	Space				Space Air Flow (Cfm)	Space Sens. Load (Btuh)	Space Lat. Load (Btuh)	Peak Time Mo/Hr	Coil				Coil Air Flow (Cfm)	Coil Sens. Load (Btuh)	Coil Lat. Load (Btuh)
			OA Cond. DB/°F	Rm Dry Bltb (F)	Supp. Dry Bulb (F)	Space Lat. Load (Btuh)					OA Cond. DB/°F	Rm Dry Bltb (F)	Supp. Dry Bulb (F)				
1	FIRST FLOOR	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	62,845	21,670	
Zone	1 Total/Ave.		96 75	78	61.2	2,872	52,144	7,038	96	79	78	62.4	2,872	62,845	21,670		
Zone	1 Block	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	62,845	21,670	
2	FIRST FLOOR	7/11	89 77	78	61.8	3,741	65,510	7,038	8/12	91	79	78	62.3	3,741	78,972	23,641	
Zone	2 Total/Ave.		89 77	78	61.8	3,741	65,510	7,038	91	79	78	62.3	3,741	78,972	23,641		
Zone	2 Block	7/11	89 77	78	61.8	3,741	65,510	7,038	8/12	91	79	78	62.3	3,741	78,972	23,641	
3	FIRST FLOOR	9/15	89 75	78	61.8	3,602	63,025	7,038	8/14	96	79	78	63.5	3,602	72,711	21,670	
Zone	3 Total/Ave.		89 75	78	61.8	3,602	63,025	7,038	96	79	78	63.5	3,602	72,711	21,670		
Zone	3 Block	9/15	89 75	78	61.8	3,602	63,025	7,038	8/14	96	79	78	63.5	3,602	72,711	21,670	
4	FIRST FLOOR	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	78,037	19,745	
Zone	4 Total/Ave.		96 75	78	62.0	3,861	66,836	7,038	96	78	78	63.6	3,861	78,037	19,745		
Zone	4 Block	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	78,037	19,745	
5	FIRST FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	757,278	280,776	
Zone	5 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299	96	79	78	62.5	34,669	757,278	280,776		
Zone	5 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	757,278	280,776	
6	SECOND FLOOR	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	62,845	21,670	
Zone	6 Total/Ave.		96 75	78	61.2	2,872	52,144	7,038	96	79	78	62.4	2,872	62,845	21,670		
Zone	6 Block	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	62,845	21,670	
7	SECOND FLOOR	7/11	89 77	78	61.8	3,741	65,510	7,038	8/12	91	79	78	62.3	3,741	78,972	23,641	
Zone	7 Total/Ave.		89 77	78	61.8	3,741	65,510	7,038	91	79	78	62.3	3,741	78,972	23,641		
Zone	7 Block	7/11	89 77	78	61.8	3,741	65,510	7,038	8/12	91	79	78	62.3	3,741	78,972	23,641	
8	SECOND FLOOR	9/15	89 75	78	61.8	3,602	63,025	7,038	8/14	96	79	78	63.5	3,602	72,711	21,670	
Zone	8 Total/Ave.		89 75	78	61.8	3,602	63,025	7,038	96	79	78	63.5	3,602	72,711	21,670		
Zone	8 Block	9/15	89 75	78	61.8	3,602	63,025	7,038	8/14	96	79	78	63.5	3,602	72,711	21,670	
9	SECOND FLOOR	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	78,037	19,745	
Zone	9 Total/Ave.		96 75	78	62.0	3,861	66,836	7,038	96	78	78	63.6	3,861	78,037	19,745		
Zone	9 Block	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	78,037	19,745	
10	SECOND FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	757,278	280,776	
Zone	10 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299	96	79	78	62.5	34,669	757,278	280,776		
Zone	10 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	757,278	280,776	
11	THIRD FLOOR	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	75,396	21,670	
Zone	11 Total/Ave.		96 75	78	61.2	2,872	52,144	7,038	96	79	78	62.4	2,872	75,396	21,670		
Zone	11 Block	7/16	96 75	78	61.2	2,872	52,144	7,038	8/14	96	79	78	62.4	2,872	75,396	21,670	
12	THIRD FLOOR	7/12	92 78	78	61.9	3,757	65,338	7,038	8/14	96	79	78	63.0	3,757	90,899	21,670	
Zone	12 Total/Ave.		92 78	78	61.9	3,757	65,338	7,038	96	79	78	63.0	3,757	90,899	21,670		
Zone	12 Block	7/12	92 78	78	61.9	3,757	65,338	7,038	8/14	96	79	78	63.0	3,757	90,899	21,670	
13	THIRD FLOOR	9/15	89 75	78	61.8	3,607	63,095	7,038	8/14	96	79	78	63.6	3,607	85,271	21,670	
Zone	13 Total/Ave.		89 75	78	61.8	3,607	63,095	7,038	96	79	78	63.6	3,607	85,271	21,670		
Zone	13 Block	9/15	89 75	78	61.8	3,607	63,095	7,038	8/14	96	79	78	63.6	3,607	85,271	21,670	
14	THIRD FLOOR	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	92,808	19,745	
Zone	14 Total/Ave.		96 75	78	62.0	3,861	66,836	7,038	96	78	78	63.6	3,861	92,808	19,745		
Zone	14 Block	7/16	96 75	78	62.0	3,861	66,836	7,038	8/15	96	78	78	63.6	3,861	92,808	19,745	
15	THIRD FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.6	34,669	918,648	280,776	
Zone	15 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299	96	79	78	62.6	34,669	918,648	280,776		
Zone	15 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.6	34,669	918,648	280,776	
System	1 Total/Ave.		96 75	78	61.9	146,258	2,542,620	367,353		96	79	78	62.7	146,258	3,362,708	1,100,534	
System	1 Block	7/16	96 75	78	62.2	146,258	2,500,886	367,353	8/14	96	79	78	62.8	146,258	3,340,811	1,102,505	

BUILDING AREAS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

BUILDING AREAS

Room Number	Description	Number of Duplicate Flr	Rm	Floor Area/Dupl Room (sqft)	Total Floor Area (sqft)	Partition Area (sqft)	Exposed Floor Area (sqft)	Skylight Area (sqft)	Skl /Rf (%)	Net Roof Area (sqft)	Window Area (sqft)	Win /Wl (%)	Net Wall Area (sqft)
1	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	1 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
2	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	2 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
3	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	3 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
4	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	4 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
5	FIRST FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0	0
Zone	5 Total/Ave.				46,225	0	0	0	0	0	0	0	0
6	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	6 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
7	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	7 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
8	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	8 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
9	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	9 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
10	SECOND FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0	0
Zone	10 Total/Ave.				46,225	0	0	0	0	0	0	0	0
11	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	11 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
12	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	12 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
13	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	13 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
14	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	14 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
15	THIRD FLOOR	1	1	46,225	46,225	0	0	0	0	46,225	0	0	0
Zone	15 Total/Ave.				46,225	0	0	0	0	46,225	0	0	0
System	1 Total/Ave.				180,075	0	0	0	0	60,025	6,174	15	34,986
Building					180,075	0	0	0	0	60,025	6,174	15	34,986

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	253,518	559	1,089	112	7
Feb	224,427	533	1,145	99	7
March	276,853	578	339	170	3
April	288,175	610	83	233	1
May	328,223	631	0	308	0
June	326,140	643	0	341	0
July	344,687	657	0	392	0
Aug	346,506	670	0	399	0
Sept	326,371	654	0	339	0
Oct	290,436	609	291	217	3
Nov	271,789	590	345	167	3
Dec	257,642	566	982	117	6
Total	3,534,766	670	4,274	2,893	7

Building Energy Consumption = 69,369 (Btu/Sq Ft/Year)  
Source Energy Consumption = 203,504 (Btu/Sq Ft/Year)

Floor Area = 180,075 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

----- EQUIPMENT ENERGY CONSUMPTION -----													
Ref	Equip	Monthly Consumption											
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
0	LIGHTS												
	ELEC	75529	68220	75529	73092	75529	73092	75529	75529	73092	75529	73092	75529
	PK	221.5	221.5	221.5	221.5	221.5	221.5	221.5	221.5	221.5	221.5	221.5	221.5
													889,291
													221.5
1	MISC LD												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
2	MISC LD												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
3	MISC LD												
	OIL	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
4	MISC LD												
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
	MISC LD												
	P HOTW20	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
6	MISC LD												
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
													0
													0.0
1	EQ1001S												
	ELEC	23120	20734	32168	42650	58988	65591	75452	77272	65821	39096	31357	24098
	PK	77.0	78.7	95.9	127.8	148.7	161.5	175.5	188.5	172.6	127.3	108.6	83.7
													556,349
													188.5
1	EQ5100												
	ELEC	7549	294	15097	19828	25881	25046	25881	25881	25046	19411	17741	8726
	PK	34.8	7.9	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
													216,383
													34.8
1	EQ5100												
	WATER	112	99	170	233	308	341	392	399	339	217	167	117
	PK	0.4	0.5	0.6	0.8	0.9	0.9	1.0	1.1	1.0	0.8	0.7	0.5
													2,893
													1.1
1	EQ5001												
	ELEC	20035	19488	26199	28337	36987	35794	36987	36987	35794	27740	25354	21576
	PK	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
													351,275
													49.7
1	EQ5010												
	ELEC	10017	9744	13099	14168	18493	17897	18493	18493	17897	13870	12677	10788
	PK	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
													175,638
													24.9
EQ5300	CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

ELEC	403	392	527	570	744	720	744	744	720	558	510	434	7,066
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	111600	100800	111600	108000	111600	108000	111600	111600	108000	111600	108000	111600	1,314,000
PK	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	1089	1145	339	83	0	0	0	0	0	291	345	982	4,274
PK	6.5	6.8	3.2	1.1	0.0	0.0	0.0	0.0	0.0	2.5	3.0	5.7	6.8
1 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	4623	4176	2312	1342	0	0	0	0	0	2312	2685	4295	21,745
PK	14.9	14.9	14.9	14.9	0.0	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9
1 EQ5240	BOILER FORCED DRAFT FAN												
ELEC	487	440	244	141	0	0	0	0	0	244	283	453	2,291
PK	1.6	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.6	1.6
1 EQ5307	BOILER CONTROLS												
ELEC	155	140	78	45	0	0	0	0	0	78	90	144	729
PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 670.3 (kW)  
Yearly Time of Peak 15 (hr) 8 (mo)

Hour 15 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
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Cooling Equipment

1	EQ1001S	2-STG CTV <555 TONS	298.8	44.58
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Sub Total			298.8	44.58
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Sub Total			0.0	0.00
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Air Moving Equipment

1		SUMMATION OF FAN ELECTRICAL DEMAND	150.0	22.38
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Sub Total			150.0	22.38
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Total			0.0	0.00
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Miscellaneous

Lights			221.5	33.04
Base Utilities			0.0	0.00
Misc Equipment			0.0	0.00
Sub Total			221.5	33.04

Grand Total			670.3	100.00
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TRACE 600 ANALYSIS

by \*\*

FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 7:37:16 4/18/94  
Dataset Name: 1350E .TM

AIRFLOW - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	21,609	143,714	143,714	143,714	21,609	0	0
Totals		21,609	143,714	143,714	143,714	21,609	0	0

CAPACITY - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

		Cooling				Heating						
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
1	VTCV	365.1	0.0	0.0	365.1	-1,570,993	0	0	0	0	0	-1,570,993
Totals		365.1	0.0	0.0	365.1	-1,570,993	0	0	0	0	0	-1,570,993

The building peaked at hour 14 month 8 with a capacity of 363.5 tons

ENGINEERING CHECKS - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	15.04	0.80	393.6	493.2	24.33	0.80	-8.72	180,075

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/14					Mo/Hr: 7/16			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 96/ 79/126.0					OADB: 96			OADB: 30		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak (Btuh)	Coil Peak (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	220,832		220,832	5.04	0	0.00	0	-163,481	10.41
Glass Solar	162,068	0		162,068	3.70	221,235	8.84	0	0	0.00
Glass Cond	93,257	0		93,257	2.13	82,137	3.28	-290,011	-290,011	18.46
Wall Cond	56,439	25,537		81,976	1.87	60,010	2.40	-139,356	-207,989	13.24
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	0			0	0.00	0	0.00	-1	-1	0.00
Sub Total==>	311,764	246,368		558,133	12.74	363,382	14.52	-429,368	-661,482	42.11
Internal Loads										
Lights	278,822	119,495		398,318	9.09	287,453	11.48	0	0	0.00
People	690,834			690,834	15.77	333,615	13.33	0	0	0.00
Misc	832,176	0	0	832,176	18.99	849,625	33.95	0	0	0.00
Sub Total==>	1,801,833	119,495	0	1,921,328	43.85	1,470,692	58.76	0	0	0.00
Ceiling Load	98,335	-98,335		0	0.00	121,227	4.84	-62,317	0	0.00
Outside Air	0	0	0	1,139,235	26.00	0	0.00	0	-935,041	59.52
Sup. Fan Heat				255,492	5.83		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	547,630			547,630	12.50	547,630	21.88	0	0	0.00
Heat		-40,287	0	-40,287	-0.92		0.00		25,531	-1.63
Minimal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	2,759,562	227,242	0	4,381,532	100.00	2,502,932	100.00	-491,686	-1,570,992	100.00

-----COOLING COIL SELECTION-----											-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR				Gross Total	Glass (sf)	(%)
Main Clg	365.1	4,381.5	3,281.2	143,714	82.1	68.0	83.4	60.3	58.6	73.5	Floor	180,075	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Part	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	0	
Totals	365.1	4,381.5									Roof	60,025	0 0
											Wall	41,160	6,174 15

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----			-----TEMPERATURES (F)-----		
	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
Main Htg	-1,571.0	143,714	63.1	73.2	Vent	21,609	21,609	Clg Cfm/Sqft	15.0		SADB	61.9	73.2
Aux Htg	0.0	0	0.0	0.0	Infil	0	0	Clg Cfm/Ton	0.80		Plenum	79.7	68.9
Preheat	-0.0	143,714	63.1	60.3	Supply	143,714	143,714	Clg Sqft/Ton	393.60		Return	79.7	68.9
Reheat	0.0	0	0.0	0.0	Mincfm	0	0	Clg Btuh/Sqft	24.33		Ret/OA	82.1	63.1
Humidif	0.0	0	0.0	0.0	Return	143,714	143,714	No. People	1,441		Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	21,609	21,609	Htg % OA	15.0		Fn MtrTD	0.4	0.4
Total	-1,571.0				Rm Exh	0	0	Htg Cfm/Sqft	0.80		Fn BldTD	0.3	0.3
					Auxil	0	0	Htg Btuh/Sqft	-8.72		Fn Frict	0.9	0.9

MAIN SYSTEM COOLING - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

PEAK COOLING LOADS  
(Main System)

Space													Coil				
Room		Peak	QA	Rm	Supp.	Space	Space	Space	Peak	QA	Rm	Supp.	Coil	Coil	Coil		
Number	Description	Time	Cond.	Dry	Dry	Air	Sens.	Lat.	Time	Cond.	Dry	Dry	Air	Sens.	Lat.		
		Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load	Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load		
			(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)		(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)		
1	FIRST FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	58,467	21,670		
Zone	1 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79 78	62.3	2,654	58,467	21,670		
Zone	1 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	58,467	21,670		
2	FIRST FLOOR	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79 78	62.2	3,529	74,713	23,641		
Zone	2 Total/Ave.		89 77	78	61.7	3,529	62,320	7,038		91	79 78	62.2	3,529	74,713	23,641		
Zone	2 Block	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79 78	62.2	3,529	74,713	23,641		
3	FIRST FLOOR	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79 78	63.5	3,379	68,324	21,670		
Zone	3 Total/Ave.		89 75	78	61.7	3,379	59,683	7,038		96	79 78	63.5	3,379	68,324	21,670		
Zone	3 Block	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79 78	63.5	3,379	68,324	21,670		
4	FIRST FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	73,649	19,662		
Zone	4 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78 78	63.6	3,668	73,649	19,662		
Zone	4 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	73,649	19,662		
5	FIRST FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.4	34,669	746,836	280,776		
Zone	5 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79 78	62.4	34,669	746,836	280,776		
Zone	5 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.4	34,669	746,836	280,776		
6	SECOND FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	58,467	21,670		
Zone	6 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79 78	62.3	2,654	58,467	21,670		
Zone	6 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	58,467	21,670		
7	SECOND FLOOR	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79 78	62.2	3,529	74,713	23,641		
Zone	7 Total/Ave.		89 77	78	61.7	3,529	62,320	7,038		91	79 78	62.2	3,529	74,713	23,641		
Zone	7 Block	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79 78	62.2	3,529	74,713	23,641		
8	SECOND FLOOR	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79 78	63.5	3,379	68,324	21,670		
Zone	8 Total/Ave.		89 75	78	61.7	3,379	59,683	7,038		96	79 78	63.5	3,379	68,324	21,670		
Zone	8 Block	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79 78	63.5	3,379	68,324	21,670		
9	SECOND FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	73,649	19,662		
Zone	9 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78 78	63.6	3,668	73,649	19,662		
Zone	9 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	73,649	19,662		
10	SECOND FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.4	34,669	746,836	280,776		
Zone	10 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79 78	62.4	34,669	746,836	280,776		
Zone	10 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.4	34,669	746,836	280,776		
11	THIRD FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	71,091	21,670		
Zone	11 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79 78	62.3	2,654	71,091	21,670		
Zone	11 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79 78	62.3	2,654	71,091	21,670		
12	THIRD FLOOR	7/12	92 78	78	61.8	3,541	62,110	7,038	8/14	96	79 78	62.9	3,541	86,598	21,670		
Zone	12 Total/Ave.		92 78	78	61.8	3,541	62,110	7,038		96	79 78	62.9	3,541	86,598	21,670		
Zone	12 Block	7/12	92 78	78	61.8	3,541	62,110	7,038	8/14	96	79 78	62.9	3,541	86,598	21,670		
13	THIRD FLOOR	9/15	89 75	78	61.7	3,384	59,753	7,038	8/14	96	79 78	63.5	3,384	80,958	21,670		
Zone	13 Total/Ave.		89 75	78	61.7	3,384	59,753	7,038		96	79 78	63.5	3,384	80,958	21,670		
Zone	13 Block	9/15	89 75	78	61.7	3,384	59,753	7,038	8/14	96	79 78	63.5	3,384	80,958	21,670		
14	THIRD FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	88,493	19,662		
Zone	14 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78 78	63.6	3,668	88,493	19,662		
Zone	14 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78 78	63.6	3,668	88,493	19,662		
15	THIRD FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.5	34,669	910,130	280,776		
Zone	15 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79 78	62.5	34,669	910,130	280,776		
Zone	15 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79 78	62.5	34,669	910,130	280,776		
System	1 Total/Ave.		96 75	78	61.9	143,714	2,502,932	367,353		96	79 78	62.6	143,714	3,281,247	1,100,285		
System	1 Block	7/16	96 75	78	62.2	143,714	2,460,781	367,353	8/14	96	79 78	62.8	143,714	3,259,253	1,102,256		

BUILDING AREAS - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

BUILDING AREAS

Room Number	Description	Number of Duplicate Flr Rm	Floor Area/Dupl Room (sqft)	Total Floor Area (sqft)	Partition Area (sqft)	Exposed Floor Area (sqft)	Skylight Area (sqft)	Skl /Rf (%)	Net Roof Area (sqft)	Window Area (sqft)	Win /Wl (%)	Net Wall Area (sqft)
1	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 1	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
2	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 2	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
3	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 3	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
4	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 4	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
5	FIRST FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0
Zone 5	Total/Ave.			46,225	0	0	0	0	0	0	0	0
6	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 6	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
7	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 7	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
8	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 8	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
9	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	515	15	2,915
Zone 9	Total/Ave.			3,450	0	0	0	0	0	515	15	2,915
10	SECOND FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0
Zone 10	Total/Ave.			46,225	0	0	0	0	0	0	0	0
11	THIRD FLOOR	1	1	3,450	3,450	0	0	0	3,450	515	15	2,915
Zone 11	Total/Ave.			3,450	0	0	0	0	3,450	515	15	2,915
12	THIRD FLOOR	1	1	3,450	3,450	0	0	0	3,450	515	15	2,915
Zone 12	Total/Ave.			3,450	0	0	0	0	3,450	515	15	2,915
13	THIRD FLOOR	1	1	3,450	3,450	0	0	0	3,450	515	15	2,915
Zone 13	Total/Ave.			3,450	0	0	0	0	3,450	515	15	2,915
14	THIRD FLOOR	1	1	3,450	3,450	0	0	0	3,450	515	15	2,915
Zone 14	Total/Ave.			3,450	0	0	0	0	3,450	515	15	2,915
15	THIRD FLOOR	1	1	46,225	46,225	0	0	0	46,225	0	0	0
Zone 15	Total/Ave.			46,225	0	0	0	0	46,225	0	0	0
System	1 Total/Ave.			180,075	0	0	0	0	60,025	6,174	15	34,986
Building				180,075	0	0	0	0	60,025	6,174	15	34,986

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	218,966	468	1,197	94	7
Feb	191,019	440	1,060	78	7
March	233,147	487	299	138	4
April	242,624	516	15	202	1
May	266,552	536	0	270	0
June	264,386	548	0	303	0
July	280,383	560	0	356	0
Aug	281,806	569	0	361	0
Sept	265,112	553	0	301	0
Oct	244,561	513	183	182	3
Nov	229,353	495	307	138	3
Dec	222,938	475	830	93	6
Total	2,940,848	569	3,890	2,515	7

Building Energy Consumption = 57,899 (Btu/Sq Ft/Year)  
 Source Energy Consumption = 169,506 (Btu/Sq Ft/Year)

Floor Area = 180,075 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

----- EQUIPMENT ENERGY CONSUMPTION -----														
Ref	Equip	Monthly Consumption												Total
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	47282	42707	47282	45757	47282	45757	47282	47282	45757	47282	45757	47282	556,711
	PK	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P WOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CTV <555 TONS												
	ELEC	20570	17497	27688	37697	49790	54347	63342	64765	55073	33575	27337	20537	472,219
	PK	69.0	72.0	87.6	117.3	137.3	159.1	187.6	199.9	183.8	113.6	95.8	76.3	199.9
1	EQ5100	COOLING TOWER												
	ELEC	7549	48	12941	16698	18333	17741	18333	18333	17741	16941	15306	8627	168,589
	PK	34.8	3.9	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
1	EQ5100	COOLING TOWER												
	WATER	94	78	138	202	270	303	356	361	301	182	138	93	2,515
	PK	0.4	0.4	0.5	0.7	0.8	1.0	1.1	1.2	1.1	0.7	0.6	0.4	1.2
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	20035	18096	22719	23862	26199	25354	26199	26199	25354	24210	21874	21576	281,676
	PK	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
1	EQ5010	CONDENSER WATER PUMP C.V.												
	ELEC	10017	9048	11360	11931	13099	12677	13099	13099	12677	12105	10937	10788	140,838
	PK	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
	EQ5300	CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

ELEC	403	364	457	480	527	510	527	527	510	487	440	434	5,666
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	107777	97349	107949	105689	111322	108000	111600	111600	108000	108465	104950	108038	1,290,740
PK	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	1197	1060	299	15	0	0	0	0	0	183	307	830	3,890
PK	7.1	6.6	3.7	0.5	0.0	0.0	0.0	0.0	0.0	2.8	3.1	5.8	7.1
1 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	4683	5190	2416	447	0	0	0	0	0	1312	2416	4966	21,431
PK	14.9	14.9	14.9	14.9	0.0	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9
1 EQ5240	BOILER FORCED DRAFT FAN												
ELEC	493	547	255	47	0	0	0	0	0	138	255	523	2,258
PK	1.6	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.6	1.6
1 EQ5307	BOILER CONTROLS												
ELEC	157	174	81	15	0	0	0	0	0	44	81	167	718
PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5



UTILITY PEAK CHECKSUMS - ALTERNATIVE 2

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value        569.3    (kW)  
Yearly Time of Peak 15 (hr)    8 (mo)

Hour 15    Month    8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
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Cooling Equipment

1	EQ1001S	2-STG CTV <555 TONS	280.6	49.29
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Sub Total			280.6	49.29
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Sub Total			0.0	0.00
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Air Moving Equipment

1		SUMMATION OF FAN ELECTRICAL DEMAND	150.0	26.35
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Sub Total			150.0	26.35
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Total			0.0	0.00
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Miscellaneous

Lights			138.7	24.36
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Base Utilities			0.0	0.00
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Misc Equipment			0.0	0.00
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Sub Total			138.7	24.36
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Grand Total			569.3	100.00
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TRACE 600 ANALYSIS \*\*  
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by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 13:22: 6 4/17/94  
Dataset Name: 1350E .TH

AIRFLOW - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	21,609	143,714	143,714	143,714	21,609	0	0
Totals		21,609	143,714	143,714	143,714	21,609	0	0

CAPACITY - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

----- Cooling ----- Heating -----												
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
1	VTCV	365.1	0.0	0.0	365.1	-1,570,993	0	0	0	0	0	-1,570,993
Totals		365.1	0.0	0.0	365.1	-1,570,993	0	0	0	0	0	-1,570,993

The building peaked at hour 14 month 8 with a capacity of 363.5 tons

ENGINEERING CHECKS - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	15.04	0.80	393.6	493.2	24.33	0.80	-8.72	180,075

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==>						Mo/Hr: 7/16			Mo/Hr: 13/ 1		
Outside Air ==>						OADB: 96			OADB: 30		
Space	Ret. Air	Ret. Air	Net	Percnt		Space	Percnt		Space Peak	Coil Peak	Percnt
Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads											
Skylite Solr	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	220,832	220,832	5.04	*	0	0.00	*	0	-163,481	10.41
Glass Solar	162,068	0	162,068	3.70	*	221,235	8.84	*	0	0	0.00
Glass Cond	93,257	0	93,257	2.13	*	82,137	3.28	*	-290,011	-290,011	18.46
Wall Cond	56,439	25,537	81,976	1.87	*	60,010	2.40	*	-139,356	-207,989	13.24
Partition	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	0	0	0	0.00	*	0	0.00	*	-1	-1	0.00
Sub Total==>	311,764	246,368	558,133	12.74	*	363,382	14.52	*	-429,368	-661,482	42.11
Internal Loads											
Lights	278,822	119,495	398,318	9.09	*	287,453	11.48	*	0	0	0.00
People	690,834		690,834	15.77	*	333,615	13.33	*	0	0	0.00
Misc	832,176	0	832,176	18.99	*	849,625	33.95	*	0	0	0.00
Sub Total==>	1,801,833	119,495	1,921,328	43.85	*	1,470,692	58.76	*	0	0	0.00
Ceiling Load	98,335	-98,335	0	0.00	*	121,227	4.84	*	-62,317	0	0.00
Outside Air	0	0	1,139,235	26.00	*	0	0.00	*	0	-935,041	59.52
Sup. Fan Heat			255,492	5.83	*		0.00	*		0	0.00
Ret. Fan Heat		0	0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0	0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	547,630		547,630	12.50	*	547,630	21.88	*	0	0	0.00
Exhaust Heat		-40,287	-40,287	-0.92	*		0.00	*		25,531	-1.63
Exhaust Bypass		0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	2,759,562	227,242	4,381,532	100.00	*	2,502,932	100.00	*	-491,686	-1,570,992	100.00

-----COOLING COIL SELECTION-----											-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
	(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor	Part	ExFlr
Main Clg	365.1	4,381.5	3,281.2	143,714	82.1	68.0	83.4	60.3	58.6	73.5	180,075	0	0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
Totals	365.1	4,381.5									60,025	41,160	6,174
													15

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA	15.0	Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent	21,609	21,609	Clg Cfm/Sqft	0.80	SADB	61.9	73.2
Main Htg	-1,571.0	143,714	63.1	73.2	Infil	0	0	Clg Cfm/Ton	393.60	Plenum	79.7	68.9
Aux Htg	0.0	0	0.0	0.0	Supply	143,714	143,714	Clg Sqft/Ton	493.18	Return	79.7	68.9
Preheat	-0.0	143,714	63.1	60.3	Mincfm	0	0	Clg Btuh/Sqft	24.33	Ret/OA	82.1	63.1
Reheat	0.0	0	0.0	0.0	Return	143,714	143,714	No. People	1,441	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	21,609	21,609	Htg % OA	15.0	Fn MtrTD	0.4	0.4
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	0.80	Fn BldTD	0.3	0.3
Total	-1,571.0				Auxil	0	0	Htg Btuh/Sqft	-8.72	Fn Frict	0.9	0.9

MAIN SYSTEM COOLING - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

PEAK COOLING LOADS  
(Main System)

		Space							Coil							
Room Number	Description	Peak	QA	Rm	Supp.	Space	Space	Space	Peak	QA	Rm	Supp.	Coil	Coil	Coil	
		Time	Cond.	Dry	Dry	Air	Sens.	Lat.	Time	Cond.	Dry	Dry	Air	Sens.	Lat.	
		Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load	Mo/Hr	DB/WB	Blb	Bulb	Flow	Load	Load	
			(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)		(F)	(F)	(F)	(Cfm)	(Btuh)	(Btuh)	
1	FIRST FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	58,467	21,670
Zone	1 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79	78	62.3	2,654	58,467	21,670
Zone	1 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	58,467	21,670
2	FIRST FLOOR	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79	78	62.2	3,529	74,713	23,641
Zone	2 Total/Ave.		89 77	78	61.7	3,529	62,320	7,038		91	79	78	62.2	3,529	74,713	23,641
Zone	2 Block	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79	78	62.2	3,529	74,713	23,641
3	FIRST FLOOR	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79	78	63.5	3,379	68,324	21,670
Zone	3 Total/Ave.		89 75	78	61.7	3,379	59,683	7,038		96	79	78	63.5	3,379	68,324	21,670
Zone	3 Block	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79	78	63.5	3,379	68,324	21,670
4	FIRST FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	73,649	19,662
Zone	4 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78	78	63.6	3,668	73,649	19,662
Zone	4 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	73,649	19,662
5	FIRST FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.4	34,669	746,836	280,776
Zone	5 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79	78	62.4	34,669	746,836	280,776
Zone	5 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.4	34,669	746,836	280,776
6	SECOND FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	58,467	21,670
Zone	6 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79	78	62.3	2,654	58,467	21,670
Zone	6 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	58,467	21,670
7	SECOND FLOOR	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79	78	62.2	3,529	74,713	23,641
Zone	7 Total/Ave.		89 77	78	61.7	3,529	62,320	7,038		91	79	78	62.2	3,529	74,713	23,641
Zone	7 Block	7/11	89 77	78	61.7	3,529	62,320	7,038	8/12	91	79	78	62.2	3,529	74,713	23,641
8	SECOND FLOOR	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79	78	63.5	3,379	68,324	21,670
Zone	8 Total/Ave.		89 75	78	61.7	3,379	59,683	7,038		96	79	78	63.5	3,379	68,324	21,670
Zone	8 Block	9/15	89 75	78	61.7	3,379	59,683	7,038	8/14	96	79	78	63.5	3,379	68,324	21,670
9	SECOND FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	73,649	19,662
Zone	9 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78	78	63.6	3,668	73,649	19,662
Zone	9 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	73,649	19,662
10	SECOND FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.4	34,669	746,836	280,776
Zone	10 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79	78	62.4	34,669	746,836	280,776
Zone	10 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.4	34,669	746,836	280,776
11	THIRD FLOOR	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	71,091	21,670
Zone	11 Total/Ave.		96 75	78	61.0	2,654	48,802	7,038		96	79	78	62.3	2,654	71,091	21,670
Zone	11 Block	7/16	96 75	78	61.0	2,654	48,802	7,038	8/14	96	79	78	62.3	2,654	71,091	21,670
12	THIRD FLOOR	7/12	92 78	78	61.8	3,541	62,110	7,038	8/14	96	79	78	62.9	3,541	86,598	21,670
Zone	12 Total/Ave.		92 78	78	61.8	3,541	62,110	7,038		96	79	78	62.9	3,541	86,598	21,670
Zone	12 Block	7/12	92 78	78	61.8	3,541	62,110	7,038	8/14	96	79	78	62.9	3,541	86,598	21,670
13	THIRD FLOOR	9/15	89 75	78	61.7	3,384	59,753	7,038	8/14	96	79	78	63.5	3,384	80,958	21,670
Zone	13 Total/Ave.		89 75	78	61.7	3,384	59,753	7,038		96	79	78	63.5	3,384	80,958	21,670
Zone	13 Block	9/15	89 75	78	61.7	3,384	59,753	7,038	8/14	96	79	78	63.5	3,384	80,958	21,670
14	THIRD FLOOR	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	88,493	19,662
Zone	14 Total/Ave.		96 75	78	62.0	3,668	63,494	7,038		96	78	78	63.6	3,668	88,493	19,662
Zone	14 Block	7/16	96 75	78	62.0	3,668	63,494	7,038	8/15	96	78	78	63.6	3,668	88,493	19,662
15	THIRD FLOOR	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	910,130	280,776
Zone	15 Total/Ave.		96 75	78	62.0	34,669	600,059	94,299		96	79	78	62.5	34,669	910,130	280,776
Zone	15 Block	7/16	96 75	78	62.0	34,669	600,059	94,299	8/14	96	79	78	62.5	34,669	910,130	280,776
System	1 Total/Ave.		96 75	78	61.9	143,714	2,502,932	367,353		96	79	78	62.6	143,714	3,281,247	1,100,285
System	1 Block	7/16	96 75	78	62.2	143,714	2,460,781	367,353	8/14	96	79	78	62.8	143,714	3,259,253	1,102,256

BUILDING AREAS - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

BUILDING AREAS

Room Number	Description	Number of Duplicate Flr	Rm	Floor Area/Dupl Room (sqft)	Total Floor Area (sqft)	Partition Area (sqft)	Exposed Floor Area (sqft)	Skylight Area (sqft)	Skl /Rf (%)	Net Roof Area (sqft)	Window Area (sqft)	Win /Wl (%)	Net Wall Area (sqft)
1	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	1 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
2	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	2 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
3	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	3 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
4	FIRST FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	4 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
5	FIRST FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0	0
Zone	5 Total/Ave.				46,225	0	0	0	0	0	0	0	0
6	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	6 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
7	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	7 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
8	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	8 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
9	SECOND FLOOR	1	1	3,450	3,450	0	0	0	0	0	515	15	2,915
Zone	9 Total/Ave.				3,450	0	0	0	0	0	515	15	2,915
10	SECOND FLOOR	1	1	46,225	46,225	0	0	0	0	0	0	0	0
Zone	10 Total/Ave.				46,225	0	0	0	0	0	0	0	0
11	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	11 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
12	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	12 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
13	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	13 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
14	THIRD FLOOR	1	1	3,450	3,450	0	0	0	0	3,450	515	15	2,915
Zone	14 Total/Ave.				3,450	0	0	0	0	3,450	515	15	2,915
15	THIRD FLOOR	1	1	46,225	46,225	0	0	0	0	46,225	0	0	0
Zone	15 Total/Ave.				46,225	0	0	0	0	46,225	0	0	0
System	1 Total/Ave.				180,075	0	0	0	0	60,025	6,174	15	34,986
Building					180,075	0	0	0	0	60,025	6,174	15	34,986

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 G1)	GAS DMND On Peak (Thrm/hr)
Jan	213,436	449	1,197	89	7
Feb	186,586	422	1,060	74	7
March	225,585	463	299	132	4
April	232,368	485	15	194	1
May	253,165	500	0	259	0
June	249,870	509	0	291	0
July	263,564	518	0	341	0
Aug	264,627	525	0	346	0
Sept	250,412	512	0	288	0
Oct	235,338	482	183	175	3
Nov	221,779	469	307	132	3
Dec	217,370	455	830	88	6
Total	2,814,098	525	3,890	2,407	7

Building Energy Consumption = 55,496 (Btu/Sq Ft/Year)  
Source Energy Consumption = 162,299 (Btu/Sq Ft/Year)

Floor Area = 180,075 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Monthly Consumption												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	47282	42707	47282	45757	47282	45757	47282	47282	45757	47282	45757	47282	556,711
	PK	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7	138.7
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S													
		2-STG CTV <555 TONS												
	ELEC	15363	13068	20680	28155	37187	40590	47308	48371	41132	25077	20418	15338	352,684
	PK	51.6	53.8	65.4	87.6	102.5	118.8	140.1	149.3	137.3	84.9	71.5	57.0	149.3
1	EQ5100													
		COOLING TOWER												
	ELEC	7226	44	12387	15983	17548	16982	17548	17548	16982	16216	14651	8258	161,375
	PK	33.3	3.8	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3
1	EQ5100													
		COOLING TOWER												
	WATER	89	74	132	194	259	291	341	346	288	175	132	88	2,407
	PK	0.4	0.4	0.5	0.7	0.8	0.9	1.1	1.1	1.1	0.7	0.6	0.4	1.1
1	EQ5001													
		CHILLED WATER PUMP C.V.												
	ELEC	20035	18096	22719	23862	26199	25354	26199	26199	25354	24210	21874	21576	281,676
	PK	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
1	EQ5010													
		CONDENSER WATER PUMP C.V.												
	ELEC	10017	9048	11360	11931	13099	12677	13099	13099	12677	12105	10937	10788	140,838
	PK	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9
	EQ5300													
		CONTROL PANEL & INTERLOCK												



EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

ELEC	403	364	457	480	527	510	527	527	510	487	440	434	5,666
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	107777	97349	107949	105689	111322	108000	111600	111600	108000	108465	104950	108038	1,290,740
PK	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	1197	1060	299	15	0	0	0	0	0	183	307	830	3,890
PK	7.1	6.6	3.7	0.5	0.0	0.0	0.0	0.0	0.0	2.8	3.1	5.8	7.1
1 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	4683	5190	2416	447	0	0	0	0	0	1312	2416	4966	21,431
PK	14.9	14.9	14.9	14.9	0.0	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9
1 EQ5240	BOILER FORCED DRAFT FAN												
ELEC	493	547	255	47	0	0	0	0	0	138	255	523	2,258
PK	1.6	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.6	1.6
1 EQ5307	BOILER CONTROLS												
ELEC	157	174	81	15	0	0	0	0	0	44	81	167	718
PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5

UTILITY PEAK CHECKSUMS - ALTERNATIVE 3

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 524.7 (kW)  
Yearly Time of Peak 15 (hr) 8 (mo)

Hour 15 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
Cooling Equipment				
1	EQ1001S	2-STG CTV <555 TONS	236.0	44.98
Sub Total			236.0	44.98
Sub Total			0.0	0.00
Air Moving Equipment				
1	SUMMATION OF FAN ELECTRICAL DEMAND		150.0	28.59
Sub Total			150.0	28.59
Total			0.0	0.00
Miscellaneous				
Lights			138.7	26.43
Base Utilities			0.0	0.00
Misc Equipment			0.0	0.00
Sub Total			138.7	26.43
Grand Total			524.7	100.00

## CARTER & BURGESS COST ESTIMATING ANALYSIS

**PROJECT NAME: FORT SAM HOUSTON EEAP**

PROJECT NO: 91109912F

**PROJECT LOCATION: SAN ANTONIO, TEXAS**

ESTIMATOR: S.P. CLARK

<b>SUBMITTAL:</b>	<b>35.0%</b>
-------------------	--------------

DATE: 26-Oct-93

ECO NO/ BUILDING: IV. D. 1) / BLDG 1350

CHECKED BY: DJY

[illegible]



# Carter & Burgess

Consultants in Engineering, Architecture,  
Planning and the Environment

## TELEPHONE REPORT

**PROJECT:** Ft. Sam Houston EEAP

**PROJECT NO:** 91109912F

**FROM:** Glen

**WITH:** Carrier

**DATE:** 10/11/93

**TO:** Scott Clark

**WITH:** Carter & Burgess

**TIME:** 4:30 pm

**PHONE NO.:** 735-6038

The following is our understanding of the subject matter covered in this conversation. If this differs from your understanding, please notify us within (5) working days.

The efficiency data for the carrier chiller, model number 19DK7894CP, in Bldg 1350 is as follows:

A. Date installed 1986, 460V/3 $\phi$ /421 FLA/302 KW 438 tons at 70 GPM chilled water and 56°F ENT/42°F LVG, 2-pass condenser with 1314 GPM at 85°F ENT/94.6°F LVG.

- .690 KW/ton (new)
- derate at 0.5%/year or .715 KW/ton

**REPORTED BY:** Scott P. Clark

SPC/rer  
91109912.T2

c: Correspondence

**TRANE**

BLDG 1350

Ft Worth Office  
Dallas District  
The Trane Company

6320 Airport Freeway  
Ft Worth TX 76117  
TEL 817 838 1300  
FAX 817 831 8135

Jerry Gray  
District Manager  
Commercial Sales

**FAX TRANSMITTAL COVER SHEET**

TO: Scott Clark

FAX NUMBER: 735-6064

FROM: Scott Wenaas

FAX NUMBER: 817-831-8135

DATE: Oct 21 '93

NO. OF PAGES: 5  
(INCLUDING COVER SHEET)

**NOTE:**

Fort Sam Houston

Chiller Selections

#1 438 tons @ .534 kW/ton

#2 438 tons @ .580 kW/ton

IF YOU DO NOT RECEIVE ALL PAGES OR HAVE ANY QUESTIONS REGARDING THIS FAX  
PLEASE CALL ME AT 817-838-1305

PROJECT : FORT SAM HOUSTON  
 LOCATION : SAN ANTONIO, TEXAS  
 BLDG. OWNER :  
 PROGRAM USER : SCOTT WENAAS  
 COMMENTS : SCOTT CLARK - CARTER & BURGESS  
 MACHINE : CVHE

TECU 28

TECU 28

## \*\*\*\*\* INPUT CONDITIONS \*\*\*\*\*

DESIGN DUTY	438		
EXITING EVAP TEMP	42	ENTERING COND TEMP	85
EVAP FLOW RATE		COND FLOW RATE	1314
ENTERING EVAP TEMP	56	EXITING COND TEMP	
EVAPORATOR PASSES	2	CONDENSER PASSES	2
FLUID TYPE	WATER	FLUID TYPE	WATER
FLUID %	0	FLUID %	0
VOLTAGE	460		
FREQUENCY	60		
REFRIGERANT	123		

*Inlet Vane Deg 87*

## \*\*\*\*\* OUTPUT DATA \*\*\*\*\*

NOTE - PERFORMANCE CERTIFIED IN ACCORDANCE WITH ARI STANDARD 550-92

NOTE - SOUND PRESSURE MEASURED IN ACCORDANCE WITH ARI STANDARD 575-87.

%LOAD		100%	75%	50%	25%
DESIGN DUTY	TONS	438	329	219	110
POWER CONSUMED	KW	254	186	129	78
KW PER DESIGN DUTY		0.580	0.566	0.589	0.712
EXIT EVAP TEMP	F	42.00	42.00	42.00	42.00
EVAP FLOW RATE	GPM	750.9			
ENTERING EVAP TEMP	F	56.00			
EVAP PD (NON-MAR)	FEET	13.12			
EVAP PD (MARINE)	FEET	13.48			
EVAP FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
ENTERING COND TEMP	F	85.00	78.75	72.50	66.25
COND FLOW RATE	GPM	1314.0			
EXIT COND TEMP	F	94.37			
COND PD (NON-MAR)	FEET	34.06			
COND PD (MARINE)	FEET	35.20			
COND FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
MAX LRA AT MOTOR KW	AMPS	2363			
RLA AT MOTOR KW	AMPS	409			
RLA AT SELECTION KW	AMPS	362			
MAXIMUM SOUND PRESSURE	dba	79			
REFRIGERANT CHARGE	LBS	1000			
SHIP WT. (W/NMAR WB.)	LBS	17074			
OPER WT. (W/NMAR WB.)	LBS	19688			

*Budget Price**\$109,500~*

1-CVHE	nton-500	volt-460	hrtz-60	type-SNGL	cpkw-287	cpim-228
evtm-TECU	evth-28	evsz-050L	evbs-500	evwp-2	orsz-560	refg-123
cdtm-TECU	cdth-28	cdsz-050L	cdb5-500	cdwp-2	cdty-STD	

modl-CVHE	nton-500	volt-460	hrtz-60	type-SNGL	cpkw-287	cpim-228
evtm-TECU	evth-28	evsz-050L	evbs-500	evwp-2	orsz-560	refg-123
cdtm-TECU	cdth-28	cdsz-050L	cdbb-500	cdwp-2	cdty-STD	

PERCENT	TONS	EX	EVAP	ENT	EVAP	ENT	COND	EX	COND	KW	KW/TON
100	438		42.0		56.0		85.0		94.4	254	0.580
90	394		42.0		54.6		82.5		90.9	221	0.561
80	350		42.0		53.2		80.0		87.4	197	0.562
70	307		42.0		51.8		77.5		84.0	174	0.568
60	263		42.0		50.4		75.0		80.6	151	0.575
50	219		42.0		49.0		72.5		77.2	129	0.589
40	175		42.0		47.6		70.0		73.8	109	0.622
30	131		42.0		46.2		67.5		70.4	89	0.677
20	88		42.0		44.8		65.0		67.0	68	0.776
15	66		42.0		44.1		63.8		65.3	58	0.883

APLV VALUE = 0.589

PERFORMANCE TESTS AT PART LOAD MAY ONLY BE QUOTED FROM THE SELECTION PROGRAM.  
25% LOAD IS THE MINIMUM ARI 550 TEST POINT.

Esc-quit

.580 kw/ton  
machine

# TRANE CENTRAVAC SELECTION PROGRAM

Rev Level 55014

Version 13.09  
Thu Oct 21, 1993

PROJECT : FORT SAM HOUSTON  
LOCATION : SAN ANTONIO, TEXAS  
BLDG. OWNER :  
PROGRAM USER : SCOTT WENAAS  
COMMENTS : SCOTT CLARK - CARTER & BURGESS  
MACHINE : CVHE

TECU 28

TECU 28

## \*\*\*\*\* INPUT CONDITIONS \*\*\*\*\*

DESIGN DUTY	438		
EXITING EVAP TEMP	42	ENTERING COND TEMP	85
EVAP FLOW RATE		COND FLOW RATE	1314
ENTERING EVAP TEMP	56	EXITING COND TEMP	
EVAPORATOR PASSES	2	CONDENSER PASSES	2
FLUID TYPE	WATER	FLUID TYPE	WATER
FLUID %	0	FLUID %	0
VOLTAGE	460		
FREQUENCY	60		
REFRIGERANT	123		

Inlet Vane Deg 55

## \*\*\*\*\* OUTPUT DATA \*\*\*\*\*

NOTE - PERFORMANCE CERTIFIED IN ACCORDANCE WITH ARI STANDARD 550-92

NOTE - SOUND PRESSURE MEASURED IN ACCORDANCE WITH ARI STANDARD 575-87.

%LOAD		100%	75%	50%	25%
DESIGN DUTY	TONS	438	329	219	110
POWER CONSUMED	KW	234	175	123	74
PER DESIGN DUTY		0.534	0.533	0.562	0.676
EV		0.555			
EXIT EVAP TEMP	F	42.00	42.00	42.00	42.00
EVAP FLOW RATE	GPM	750.9			
ENTERING EVAP TEMP	F	56.00			
EVAP PD (NON-MAR)	FEET	6.63			
EVAP PD (MARINE)	FEET	6.74			
EVAP FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
ENTERING COND TEMP	F	85.00	78.75	72.50	66.25
COND FLOW RATE	GPM	1314.0			
EXIT COND TEMP	F	94.28			
COND PD (NON-MAR)	FEET	15.25			
COND PD (MARINE)	FEET	15.71			
COND FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
MAX LRA AT MOTOR KW	AMPS	3336			
RLA AT MOTOR KW	AMPS	449			
RLA AT SELECTION KW	AMPS	325			
MAXIMUM SOUND PRESSURE	dba	82			
REFRIGERANT CHARGE	LBS	1450			
SHIP WT. (W/NMAR WB.)	LBS	24204			
R WT. (W/NMAR WB.)	LBS	28175			

Budget Price

\$139,000-

modl-CVHE	nton-560	volt-460	hrtz-60	type-SNGL	cpkw-323	cpim-230
evtm-TECU	evth-28	evsz-080L	evbs-710	evwp-2	orsz-500	refg-123
cdtm-TECU	cdth-28	cdsz-080L	cdbz-800	cdwp-2	cdty-STD	



modl-CVHE nton-560 volt-460 hrtz-60 type-SNGL cpkw-323 cpim-230  
 evtm-TECU evth-28 evsz-080L evbs-710 evwp-2 orsz-500 refig-123  
 cdtm-TECU cdth-28 cdsz-080L cdbbs-800 cdwp-2 cdtty-STD

PERCENT	TONS	EX	EVAP	ENT	EVAP	ENT	COND	EX	COND	KW	KW/TON
100	438		42.0		56.0		85.0		94.3	234	0.534
90	394		42.0		54.6		82.5		90.8	209	0.530
80	350		42.0		53.2		80.0		87.4	185	0.528
70	307		42.0		51.8		77.5		84.0	163	0.532
60	263		42.0		50.4		75.0		80.6	143	0.544
50	219		42.0		49.0		72.5		77.2	123	0.562
40	175		42.0		47.6		70.0		73.8	104	0.594
30	131		42.0		46.2		67.5		70.4	84	0.639
20	88		42.0		44.8		65.0		67.0	65	0.742
15	66		42.0		44.1		63.8		65.3	55	0.837

APLV VALUE = 0.555

PERFORMANCE TESTS AT PART LOAD MAY ONLY BE QUOTED FROM THE SELECTION PROGRAM.  
 25% LOAD IS THE MINIMUM ARI 550 TEST POINT.  
 Esc-quit

.534 kw/ton  
 machine

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1350 - ECO IV. D. 1) - REPLACE CHILLER W/ HIGHER EFF/CFC FREE CHILLEF  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$208,060		
B. SIOH	\$11,443		
C. DESIGN COST	\$12,484		
D. TOTAL COST (1A+1B+1C)	\$231,987		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$231,987

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	432.6	\$4,564	14.65	\$66,862
B. DIST			\$0	17.70	\$0
C. RESID			\$0	20.99	\$0
D. NG	\$3.31	0.00	\$0	20.60	\$0
E. PPG			\$0	13.59	\$0
F. COAL			\$0	16.32	\$0
G. SOLAR			\$0	13.59	\$0
H. GEOTH			\$0	13.59	\$0
I. BIOMA			\$0	13.59	\$0
J. REFUS			\$0	13.59	\$0
K. WIND			\$0	13.59	\$0
L. OTHER			\$0	13.59	\$0
M. DEMAND SAVINGS			\$3,520	13.59	\$47,837
N. TOTAL		432.6	\$8,084		\$114,698

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$0		
1. DISCOUNT FACTOR (TABLE A)			
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$0

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

	ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a.	N/A	\$0	1	0.96	\$0
b.	N/A	\$0	2	0.92	\$0
c.	N/A	\$0	3	0.89	\$0
d.	N/A	\$0	4	0.85	\$0
e.	N/A	\$0	5	0.82	\$0
f.	N/A	\$0	6	0.79	\$0
g.	N/A	\$0	7	0.76	\$0
h.	N/A	\$0	8	0.73	\$0
i.	N/A	\$0	9	0.7	\$0
j.	N/A	\$0	10	0.68	\$0
k.	N/A	\$0	11	0.65	\$0
l.	N/A	\$0	12	0.62	\$0
m.	N/A	\$0	13	0.6	\$0
n.	N/A	\$0	14	0.58	\$0
o.	Chiller	\$231,987	15	0.56	\$129,913
p.	TOTAL	\$231,987			\$129,913

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$129,913

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 11.8 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$244,611

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 1.05

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 4.3%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1350

ECO NO: VII D. & IX C. D.

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings: 23.724 KWH/yr  
Demand Savings: 66.98 KW/yr  
Gas Savings: n/a MCF/yr  
Cost Savings: \$ 2,783 /yr  
Implementation Cost: \$ 9,130  
Simple Payback: 3.3 Years  
Savings to Investment:  
Ratio (SIR): 3.45

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting system to improve efficiency while maintaining or increasing lighting levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
191	1-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.
4	2-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.
24	4-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned} \text{Demand Savings} &= 66.98 \text{ KW} \times \left(\frac{4}{12}\right) \times \$7.50/\text{KW} + 66.98 \text{ KW} \times \left(\frac{8}{12}\right) \times \$6.25/\text{KW} \\ &= \$446.53/\text{yr} \end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Total LCC \$	Present Value Energy LCC \$	Annual Value Total LCC \$	Annual Value Energy LCC \$
BLD1350A	39444	55090	113681	8365	23724	6.728	1.322	8188	6834	98659	503	7259
*BLD1350B	63168	0	168771	12418	0	0.000	0.000	0	10760	158011	792	11627

Project Description: FT SAM HOUSTON EEAP

File Name	Case Description
BLD1350A	POST RETROFIT CONDITIONS
BLD1350B	EXISTING CONDITIONS

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Whole Building Summary Report

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350A.WBR  
 Date: 10/16/1993

Lighting Annual : 39444 kWh  
 Lighting Capacity : 9.281 kW  
 Annual Cooling Effect : 55072 kWh  
 Annual Heating Effect : 5635 kWh  
 Total Surveyed Floor Area: 12052 SqFt  
 Percent Survey Completed : 1205200 %  
 Lighting Power Density : 0.770 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	8188	41162	6834	58464	-967	113681
AVLCC \$	602	3029	503	4302	-71	8365

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350A.LLR

Date: 10/16/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	30.9	4.9	15.0	8.15	4-serving	7-kitchen
Measured	30.7	0.0	17.4	9.67	4-serving	9-office
Required	75.0	10.0	40.9	19.70	4-serving	2-stor

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	8.1	-45.1	-25.9	20.76	1-dining	7-kitchen
Meas - Req.	14.6	-44.3	-23.5	20.08	2-stor	4-serving



Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 1 lamp 1x4 lay-in

Rooms Served: 8  
Floor Area: 9412 SqFt  
Possible kW: 2.060  
Working kW: 2.060  
Capacity kW: 2.060  
Lighting: 8755 Annual kWh  
Heating: 1251 Annual kWh  
Cooling: 12112 Annual kWh  
Op Hours/Year: 4250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 92.7 Months  
Power Density: 0.219 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	63	63	63.0
Working	63	63	63.0
Capacity	63	63	63.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	9137	1822	12829	-215	25844
AVLCC \$	672	134	944	-16	1902

System Number: 2      Descrip: 2x4 lay-in w/acrylic

Rooms Served: 2  
Floor Area: 6496 SqFt  
Possible kW: 0.251  
Working kW: 0.251  
Capacity kW: 0.251  
Lighting: 1068 Annual kWh  
Heating: 153 Annual kWh  
Cooling: 1477 Annual kWh  
Op Hours/Year: 4250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 92.7 Months  
Power Density: 0.039 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	8	4.0
Working	4	8	4.0
Capacity	4	8	4.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1114	146	1564	-26	2962
AVLCC \$	82	11	115	-2	218

System Number: 3      Descrip: cove

Rooms Served: 2  
 Floor Area: 6496 SqFt  
 Possible kW: 4.186  
 Working kW: 4.186  
 Capacity kW: 4.186  
 Lighting: 17789 Annual kWh  
 Heating: 2541 Annual kWh  
 Cooling: 25115 Annual kWh  
 Op Hours/Year: 4250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.7 Months  
 Power Density: 0.644 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	128	128	128.0
Working	128	128	128.0
Capacity	128	128	128.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	18564	3587	26732	-436	52929
AVLCC \$	1366	264	1967	-32	3895

System Number: 4      Descrip: 4 lamp 2x4 lay-in w/ acrylic

Rooms Served: 4  
 Floor Area: 2640 SqFt  
 Possible kW: 2.784  
 Working kW: 2.784  
 Capacity kW: 2.784  
 Lighting: 11832 Annual kWh  
 Heating: 1690 Annual kWh  
 Cooling: 16368 Annual kWh  
 Op Hours/Year: 4250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.7 Months  
 Power Density: 1.055 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	24	96	24.0
Working	24	96	24.0
Capacity	24	96	24.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	12347	1279	17338	-290	31946
AVLCC \$	909	94	1276	-21	2351

# Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM2 Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Calc. FootC	Req. FootC	
1-dining	1	2	6496	192 1 lamp 1x4	1177	1177	0.18	cove	4186	4186	0.64 2x4 lay-in	251	251	0.04	5614	0.86	17.4	22.1
2-stor	1	1	96	2 4 lamp 2x4	116	116	1.21								116	1.21	24.6	17.7
3-scully	1	1	728	2 4 lamp 2x4	580	580	0.80								580	0.80	26.0	18.6
4-serving	1	1	1564	6 4 lamp 2x4	1856	1856	1.19								1856	1.19	30.7	30.9
5-kitchen	1	1	312	2 1 lamp 1x4	98	98	0.31								98	0.31	25.4	7.0
6-serving	1	2	748	3 1 lamp 1x4	262	262	0.35								262	0.35	19.6	7.8
7-kitchen	1	1	1344	8 1 lamp 1x4	262	262	0.19								262	0.19	8.3	4.9
8-food pre	1	1	320	2 1 lamp 1x4	131	131	0.41								131	0.41	9.3	8.5
9-office	1	1	252	2 4 lamp 2x4	232	232	0.92								232	0.92	0.0	18.5
10-kitchen	1	1	192	2 1 lamp 1x4	131	131	0.68								131	0.68	13.0	13.8

Total Rooms : 12  
 Total Area Sqft : 12052  
 Total People : 416  
 Total Working kW : 9.281  
 Total Potential kW : 9.281  
 Power Density W/sqft : 0.770

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350B.WBR

Date: 10/16/1993

Lighting Annual : 63168 kWh  
 Lighting Capacity : 14.863 kW  
 Annual Cooling Effect : 88205 kWh  
 Annual Heating Effect : 9024 kWh  
 Total Surveyed Floor Area: 12052 SqFt  
 Percent Survey Completed : 1205200 %  
 Lighting Power Density : 1.233 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	65920	10760	93640	-1548	168771
AVLCC \$	0	4850	792	6890	-114	12418

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1350\BLD1350B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 1 lamp 1x4 lay-in

Rooms Served: 8  
Floor Area: 9412 SqFt  
Possible kW: 3.087  
Working kW: 2.891  
Capacity kW: 3.087  
Lighting: 13120 Annual kWh  
Heating: 1874 Annual kWh  
Cooling: 18150 Annual kWh  
Op Hours/Year: 4250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 92.7 Months  
Power Density: 0.307 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	63	63	63.0
Working	63	59	59.0
Capacity	63	63	63.0
Disconnected	0	0	0.0
Broken/Burned	0	4	4.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	13691	2696	19224	-322	35291
AVLCC \$	1007	198	1415	-24	2597

System Number: 2      Descrip: 2x4 lay-in w/acrylic

Rooms Served: 2  
Floor Area: 6496 SqFt  
Possible kW: 0.384  
Working kW: 0.384  
Capacity kW: 0.384  
Lighting: 1632 Annual kWh  
Heating: 233 Annual kWh  
Cooling: 2258 Annual kWh  
Op Hours/Year: 4250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 92.7 Months  
Power Density: 0.059 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	8	4.0
Working	4	8	4.0
Capacity	4	8	4.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1703	239	2391	-40	4294
AVLCC \$	125	18	176	-3	316

System Number: 3      Descrip: cove

Rooms Served: 2  
 Floor Area: 6496 SqFt  
 Possible kW: 6.784  
 Working kW: 6.784  
 Capacity kW: 6.784  
 Lighting: 28832 Annual kWh  
 Heating: 4119 Annual kWh  
 Cooling: 40706 Annual kWh  
 Op Hours/Year: 4250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.7 Months  
 Power Density: 1.044 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	128	128	128.0
Working	128	128	128.0
Capacity	128	128	128.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	30088	5430	43328	-707	78139
AVLCC \$	2214	400	3188	-52	5750

System Number: 4      Descrip: 4 lamp 2x4 lay-in w/ acrylic

Rooms Served: 4  
 Floor Area: 2640 SqFt  
 Possible kW: 4.608  
 Working kW: 4.608  
 Capacity kW: 4.608  
 Lighting: 19584 Annual kWh  
 Heating: 2798 Annual kWh  
 Cooling: 27092 Annual kWh  
 Op Hours/Year: 4250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 92.7 Months  
 Power Density: 1.745 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	24	96	24.0
Working	24	96	24.0
Capacity	24	96	24.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	20437	2394	28697	-480	51048
AVLCC \$	1504	176	2112	-35	3756

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1350 - ECO VII D. & IX C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$8,188		
B. SIOH	\$450		
C. DESIGN COST	\$491		
D. TOTAL COST (1A+1B+1C)	\$9,130		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$9,130

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	80.97	\$854	11.77	\$10,054
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	113.1	\$1,193	11.12	\$13,268
M. DEMAND SAVINGS			\$447	11.12	\$4,965
N. TOTAL		194.07	\$2,494		\$28,288

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$289		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$3,208

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

	ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a.	N/A	\$0	1	0.96	\$0
b.	N/A	\$0	2	0.92	\$0
c.	N/A	\$0	3	0.89	\$0
d.	N/A	\$0	4	0.85	\$0
e.	N/A	\$0	5	0.82	\$0
f.	N/A	\$0	6	0.79	\$0
g.	N/A	\$0	7	0.76	\$0
h.	N/A	\$0	8	0.73	\$0
i.	N/A	\$0	9	0.7	\$0
j.	N/A	\$0	10	0.68	\$0
k.	N/A	\$0	11	0.65	\$0
l.	N/A	\$0	12	0.62	\$0
m.	N/A	\$0	13	0.6	\$0
n.	N/A	\$0	14	0.58	\$0
o.	N/A	\$0	15	0.56	\$0
p.	TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$3,208

4. SIMPLE PAYBACK  $1G / (2N3 + 3A + (3Bp1 / \text{ECONOMIC LIFE}))$ : 3.3 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$31,496

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 3.45

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 13.0%



## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 1387 - MINI-MALL**

Building 1387 is a one story brick facility consisting of several retail shops. This facility contains a small kitchen and dining area which consists of 3,700 square feet.

The operating hours for this facility are from 10:00 am to 9:00 pm, seven days per week.

The lighting system is primarily fluorescent.

The mechanical system consists of DX split systems with gas heating.

Hot water is provided to the kitchen by a gas fired heater. Dishwashing is done by hand using a rinse sink with an electric hot water booster heater.

The following ECO's are recommended for Building 1387:

1. VII. D - Reduce indoor/outdoor lighting to AEI levels
2. IX. A - Replace incandescent lamps with compact fluorescents
3. IX. C - Replace standard lamps with energy saving lamps
4. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1387

ECO NO: VII D. & IX A. C. D.

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings: 19,311 KWH/yr  
Demand Savings: 29.9 KW/yr  
Gas Savings: n/a MCF/yr  
Cost Savings: \$ 1,022 /yr  
Implementation Cost: \$ 2,592  
Simple Payback: 2.5 Years  
Savings to Investment:  
Ratio (SIR): 4.46

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
2	1-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.
20	2-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.
20	4-Lamp, 4' Fluor.	Retrofit with T8 lamps and elect. ballasts.
14	Incandescent downlights	Retrofit with compact fluor. lamps.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= (6.544 \text{ KWH} - 4.052 \text{ KWH}) \times 4 \text{ mo.} \times \$7.50 + (6.544 - 4.052) \times 8 \text{ mo.} \times \$6.25 \\ &= \$199.36/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD1387A	13170	20952	40013	2944	8098	9.015	0.542	2324	2949	34740	217	2556
*BLD1387B	21268	0	60965	4486	0	0.000	0.000	0	4676	56288	344	4142

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD1387A	POST RETROFIT CONDITIONS
BLD1387B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1387\BLD1387A.WBR

Date: 10/16/1993

Lighting Annual : 13170 kWh  
 Lighting Capacity : 4.052 kW  
 Annual Cooling Effect : 18073 kWh  
 Annual Heating Effect : 1881 kWh  
 Total Surveyed Floor Area: 3666 SqFt  
 Percent Survey Completed : 366600 %  
 Lighting Power Density : 1.105 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2324	14813	2949	20250	-323	40013
AVLCC \$	171	1090	217	1490	-24	2944

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1387\BLD1387A.LLR

Date: 10/16/1993

Room Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	75.7	14.0	33.9	23.73	6-prep/stor	1-game
Measured	51.3	8.5	26.9	17.10	4-kitchen	1-game
Required	75.0	20.0	54.2	24.78	2-dining	1-game

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	25.7	-55.0	-20.3	28.59	6-prep/stor	2-dining
Meas - Req.	-11.5	-44.6	-27.3	13.20	1-game	5-kitchen

Lighting System Survey Summary  
One Page for Each Defined System

ject: FT SAM HOUSTON EEAP  
ile: H:\JOB\911099\12F\ELECT\FLEX\OUT\1387\BLD1387A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 2x4 2 lamp

Rooms Served: 3  
Floor Area: 2536 SqFt  
Possible kW: 1.256  
Working kW: 1.256  
Capacity kW: 1.256  
Lighting: 4082 Annual kWh  
Heating: 583 Annual kWh  
Cooling: 5594 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 110.7 Months  
Power Density: 0.495 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	20	40	20.0
Working	20	40	20.0
Capacity	20	40	20.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4591	542	6263	-100	12117
AVLCC \$	338	40	461	-7	892

System Number: 2      Descrip: PL downlight

ms Served: 1  
Floor Area: 648 SqFt  
Possible kW: 0.048  
Working kW: 0.048  
Capacity kW: 0.048  
Lighting: 156 Annual kWh  
Heating: 22 Annual kWh  
Cooling: 219 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 49.8 Months  
Power Density: 0.074 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	2.0
Working	2	2	2.0
Capacity	2	2	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	175	182	249	-4	646
AVLCC \$	13	13	18	-0	48

System Number: 3      Descrip: decor. fluor. (pool)

Rooms Served: 1  
 Floor Area: 648 SqFt  
 Possible kW: 0.065  
 Working kW: 0.065  
 Capacity kW: 0.065  
 Lighting: 213 Annual kWh  
 Heating: 30 Annual kWh  
 Cooling: 298 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 110.7 Months  
 Power Density: 0.101 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	2.0
Working	2	2	2.0
Capacity	2	2	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	239	51	339	-5	735
AVLCC \$	18	4	25	-0	54

System Number: 4      Descrip: PL downlight

Rooms Served: 1  
 Floor Area: 1696 SqFt  
 Possible kW: 0.264  
 Working kW: 0.264  
 Capacity kW: 0.264  
 Lighting: 858 Annual kWh  
 Heating: 123 Annual kWh  
 Cooling: 1176 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 49.8 Months  
 Power Density: 0.156 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	11	11	11.0
Working	11	11	11.0
Capacity	11	11	11.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	965	1000	1316	-21	3459
AVLCC \$	71	74	97	-2	255



System Number: 5      Descrip: track w/ 27w PL

Rooms Served: 1  
 Floor Area: 1696 SqFt  
 Possible kW: 0.027  
 Working kW: 0.027  
 Capacity kW: 0.027  
 Lighting: 88 Annual kWh  
 Heating: 13 Annual kWh  
 Cooling: 123 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 55.3 Months  
 Power Density: 0.016 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	1.0
Working	1	1	1.0
Capacity	1	1	1.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	99	88	140	-2	351
AVLCC \$	7	6	10	-0	26

System Number: 6      Descrip: rec. fluor.

Rooms Served: 3  
 Floor Area: 1130 SqFt  
 Possible kW: 2.320  
 Working kW: 2.320  
 Capacity kW: 2.320  
 Lighting: 7540 Annual kWh  
 Heating: 1077 Annual kWh  
 Cooling: 10333 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 110.7 Months  
 Power Density: 2.053 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	20	80	20.0
Working	20	80	20.0
Capacity	20	80	20.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	8480	812	11569	-185	21736
AVLCC \$	624	60	851	-14	1599

System Number: 7      Descrip: incan. decorative

Rooms Served: 1  
Floor Area: 456 SqFt  
Possible kW: 0.072  
Working kW: 0.072  
Capacity kW: 0.072  
Lighting: 234 Annual kWh  
Heating: 33 Annual kWh  
Cooling: 329 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 49.8 Months  
Power Density: 0.158 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	3	3.0
Working	3	3	3.0
Capacity	3	3	3.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	263	273	374	-6	969
AVLCC \$	19	20	27	-0	71

Project: FT SAM HOUSTON EEAP  
File: H:\J08\91109\12\ELECT\FLEX\OUT\1387\BLD1387A.RRR  
Date: 10/16/1993

Room Name	Floor	#	Total * Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM2 Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Calc. Footc	Req. Footc
1-garage	1	1	648	6 2x4 2 lamp	251	251	0.39	PL downlig	48	48	0.07	decor. flu	65	65	0.10	365	8.5
2-dining	1	1	1696	9 2x4 2 lamp	879	879	0.52	PL downlig	264	264	0.16	track w/ 2	1770	1170	0.69	41.6	20.0
3-office	10	1	192	2 2x4 2 lamp	126	126	0.65						126	126	0.65	16.3	14.9
4-kitchen	1	1	456	3 rec. fluor	696	696	1.53	incan. dec	72	72	0.16		768	768	1.68	51.3	30.0
5-kitchen	1	1	418	2 rec. fluor	696	696	1.67						696	696	1.67	33.9	75.0
6-prep/sto	1	1	256	0 rec. fluor	928	928	3.63						928	928	3.63	13.3	50.0

Total Rooms	:	6
Total Area Sqft	:	3666
Total People	:	22
Total Working kW	:	4.052
Total Potential kW	:	4.052
Power Density W/sqft	:	1.105

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1387\BLD1387B.WBR

Date: 10/16/1993

Lighting Annual : 21268 kWh  
 Lighting Capacity : 6.544 kW  
 Annual Cooling Effect : 29286 kWh  
 Annual Heating Effect : 3038 kWh  
 Total Surveyed Floor Area: 3666 Sqft  
 Percent Survey Completed : 366600 %  
 Lighting Power Density : 1.785 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	23920	4676	32889	-521	60965
AVLCC \$	0	1760	344	2420	-38	4486

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1387\BLD1387B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 2x4 2 lamp

Rooms Served: 3  
Floor Area: 2536 SqFt  
Possible kW: 1.920  
Working kW: 1.920  
Capacity kW: 1.920  
Lighting: 6240 Annual kWh  
Heating: 891 Annual kWh  
Cooling: 8552 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 110.7 Months  
Power Density: 0.757 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	20	40	20.0
Working	20	40	20.0
Capacity	20	40	20.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	7018	898	9574	-153	17337
AVLCC \$	516	66	704	-11	1276

System Number: 2      Descrip: surface incan. can

Rooms Served: 1  
Floor Area: 648 SqFt  
Possible kW: 0.120  
Working kW: 0.120  
Capacity kW: 0.120  
Lighting: 390 Annual kWh  
Heating: 56 Annual kWh  
Cooling: 548 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 3.7 Months  
Power Density: 0.185 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	0.0
Working	2	2	0.0
Capacity	2	2	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	439	252	623	-10	1304
AVLCC \$	32	19	46	-1	96

System Number: 3      Descrip: decor. fluor. (pool)

Rooms Served: 1  
 Floor Area: 648 SqFt  
 Possible kW: 0.106  
 Working kW: 0.106  
 Capacity kW: 0.106  
 Lighting: 345 Annual kWh  
 Heating: 49 Annual kWh  
 Cooling: 484 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 110.7 Months  
 Power Density: 0.164 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	2.0
Working	2	2	2.0
Capacity	2	2	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	387	63	550	-8	992
AVLCC \$	29	5	40	-1	73

System Number: 4      Descrip: rec. incan. can

Rooms Served: 1  
 Floor Area: 1696 SqFt  
 Possible kW: 0.660  
 Working kW: 0.660  
 Capacity kW: 0.660  
 Lighting: 2145 Annual kWh  
 Heating: 306 Annual kWh  
 Cooling: 2940 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 3.7 Months  
 Power Density: 0.389 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	11	11	0.0
Working	11	11	0.0
Capacity	11	11	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2412	1388	3291	-53	7039
AVLCC \$	178	102	242	-4	518

System Number: 5      Descrip: track

Rooms Served: 1  
 Floor Area: 1696 SqFt  
 Possible kW: 0.750  
 Working kW: 0.750  
 Capacity kW: 0.750  
 Lighting: 2438 Annual kWh  
 Heating: 348 Annual kWh  
 Cooling: 3422 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 7.0 Months  
 Power Density: 0.442 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	5	0.0
Working	1	5	0.0
Capacity	1	5	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2741	516	3891	-60	7089
AVLCC \$	202	38	286	-4	522

System Number: 6      Descrip: rec. fluor.

Rooms Served: 3  
 Floor Area: 1130 SqFt  
 Possible kW: 2.688  
 Working kW: 2.544  
 Capacity kW: 3.840  
 Lighting: 8736 Annual kWh  
 Heating: 1248 Annual kWh  
 Cooling: 11972 Annual kWh  
 Op Hours/Year: 3250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 110.7 Months  
 Power Density: 2.251 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	16	56	14.0
Working	16	53	12.0
Capacity	20	80	20.0
Disconnected	4	8	6.0
Broken/Burned	0	3	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	9825	1054	13404	-214	24069
AVLCC \$	723	78	986	-16	1771

System Number: 7      Descrip: incan. decorating

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Rooms Served: 1  
Floor Area: 456 SqFt  
Possible kW: 0.300  
Working kW: 0.300  
Capacity kW: 0.300  
Lighting: 975 Annual kWh  
Heating: 139 Annual kWh  
Cooling: 1369 Annual kWh  
Op Hours/Year: 3250 Annual Hrs  
Relamp Method: Spot  
Relamp Time: 2.8 Months  
Power Density: 0.658 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	3	0.0
Working	3	3	0.0
Capacity	3	3	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1097	505	1557	-24	3134
AVLCC \$	81	37	115	-2	231



# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1387 - ECO VII D. & IX A, C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	<u>\$2,324</u>	
B. SIOH	<u>\$128</u>	
C. DESIGN COST	<u>\$139</u>	
D. TOTAL COST (1A+1B+1C)	<u>\$2,591</u>	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	<u>\$0</u>	
F. PUBLIC UTILITY COMPANY REBATE	<u>\$0</u>	
G. TOTAL INVESTMENT (1D-1E-1F)		<u>\$2,591</u>

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	<u>\$10.55</u>	<u>27.64</u>	<u>\$292</u>	<u>11.77</u>	<u>\$3,432</u>
B. DIST			<u>\$0</u>	<u>13.83</u>	<u>\$0</u>
C. RESID			<u>\$0</u>	<u>16.15</u>	<u>\$0</u>
D. NG	<u>\$3.31</u>	<u>0.00</u>	<u>\$0</u>	<u>15.34</u>	<u>\$0</u>
E. PPG			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
F. COAL			<u>\$0</u>	<u>12.82</u>	<u>\$0</u>
G. SOLAR			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
H. GEOTH			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
I. BIOMA			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
J. REFUS			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
K. WIND			<u>\$0</u>	<u>11.12</u>	<u>\$0</u>
L. COOLING	<u>\$10.55</u>	<u>38.27</u>	<u>\$404</u>	<u>11.12</u>	<u>\$4,490</u>
M. DEMAND SAVINGS			<u>\$199</u>	<u>11.12</u>	<u>\$2,217</u>
N. TOTAL		<u>65.91</u>	<u>\$895</u>		<u>\$10,139</u>

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	<u>\$127</u>	
1. DISCOUNT FACTOR (TABLE A)	<u>11.1</u>	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)		<u>\$1,410</u>

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

## **C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)**

\$1,410

## **4. SIMPLE PAYBACK 1G/(2N3+3A+(3Bp1/ECONOMIC LIFE)):**

2.5 YEARS

## **5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):**

\$11,548

## **6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G:**

4.46

## **7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):**

14.9%

## ENERGY CONSERVATION ANALYSIS

### BUILDING 1395 - NCE CLUB

Building 1395 is a one story rock building consisting of 26,000 square feet. This facility contains a full service kitchen and a large ballroom/dining area which consists of 6,000 square feet.

The operating hours are from 10:00 am to 10:00 pm Monday thru Friday and 10:00 am to 12:00 midnight on Saturday.

The lighting systems in the dining/ballroom are primarily incandescents with dimmers. The kitchen area lighting system is primarily fluorescent.

The mechanical system consists of multizone air handling units served by one air cooled reciprocating chiller and one water cooled centrifugal chiller. Heating is supplied by a gas fired boiler in the main mechanical room.

Hot water is provided by a gas fired water heater located in the main mechanical room. Dishwashing is accomplished using an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 1395:

1. IV.D. 1) - Replace chiller with higher EFF/CFC free chiller
2. VII. D - Reduce indoor/outdoor lighting to AEI levels
3. IX A. - Replace incandescent lamps with compact fluorescents
4. IX C. - Replace standard lamps with energy saving lamps
5. IX D. - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1395

ECO NO: IV.D 1)

ECO NAME: Replace chiller with higher efficiency, CFC free chiller.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>123,020</u>	KWH/yr
Demand Savings:	<u>1,152</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 12,302</u>	/yr
Implementation Cost:	<u>\$ 159,262</u>	
Simple Payback:	<u>8.2</u>	Years
Savings to Investment: Ratio (SIR):	<u>1.81</u>	

#### ECO DESCRIPTION:

Currently, two chillers serve Building 1395. One is an 80 ton air cooled chiller with an efficiency of 1.33 KW/ton which was installed in 1986. The other chiller is a 160 ton water cooled centrifugal chiller with an efficiency of 1.04 KW/ton which was installed in 1968. The air cooled chiller utilizes R-22 refrigerant and the water cooled chiller utilizes R-11 refrigerant. This ECO analyzes replacing these two chillers with one 234 ton, CFC free, high efficiency, water cooled chiller with an efficiency of .632 KW/ton.

The new chiller should be specified with part-load operation down to 10% of the maximum chiller output to provide adequate turndown. Currently, there is not redundancy or back-up capacity due to the fact that the existing chillers serve separate areas. This ECO accounts for the interdependencies related to the UMCS system and the proposed lighting retrofit.

#### COST SAVINGS CALCULATIONS:

(Refer to following Trace Output)

$$\begin{aligned} \text{Demand Savings} &= (495 \text{ KW} - 396 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (495 \text{ KW} - 396 \text{ KW}) \times 8 \text{ mo.} \times \$6.50/\text{KW} \\ &= \$8,118/\text{yr} \end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

LINE #	
1	JOB - 1
2	01/FORT SAM HOUSTON EEAP
3	01/SAN ANTONIO
	01/FWD-COE
	01/SCOTT CLARK
6	01/EEAP ALTERNATIVES
7	08/SANANTON///97/74/29
8	09/JAN/DEC
9	10/CLTD-CLF
10	LOAD - 1
11	19/1/ENERGY CONSERVATION SIMULATION
12	20/110/11/MZ AHU-1 ZONE 1/86/32/8/4//14
13	20/120/12/MZ AHU-1 ZONE 2/80/76/8/4//14
14	20/130/13/MZ AHU-1 ZONE 3/17/19/8/4//14
15	20/210/21/SZ AHU-2/51/37/8/4//14
16	20/300/30/MZ AC-1 ZONE A/92/78/8/4//14
17	20/310/31/MZ AC-1 ZONE B/26/53/8/4//14
18	20/320/32/MZ AC-1 ZONE C/2124/1/8/4//14
19	20/330/33/MZ AC-1 ZONE D/70/54/8/4//14
20	20/410/41/SZ AC-2/90/34/8/4//14
21	20/510/51/SZ AC-3/46/64/8/4//14
22	20/610/61/SZ AC-4/42/25/8/4//14
23	21/M/78/50/78//70/70//ZONE//NO
24	22/110/1/YES///.07/47
25	22/120/1/YES///.07/47
26	22/130/1/YES///.07/47
27	22/210/1/YES///.07/47
28	22/300/1/YES///.07/47
29	22/310/1/YES///.07/47
30	22/320/1/YES///.07/47
31	22/330/1/YES///.07/47
32	22/410/1/YES///.07/47
33	22/510/1/YES///.07/47
34	22/610/1/YES///.07/47
35	24/110/1/86/14/0.15/64/270
36	24/120/1/60/14/0.15/64/180
37	24/130/1/19/14/0.15/64/180
38	24/210/1/51/14/0.15/64/90
39	24/210/2/37/14/0.15/64/180
40	24/300/1/78/14/0.15/64/180
41	24/320/1/12/14/0.15/64/334
42	24/320/2/12/14/0.15/64/0
43	24/320/3/12/14/0.15/64/26
44	24/320/4/12/14/0.15/64/52
45	24/320/5/12/14/0.15/64/78
46	24/330/1/44/14/0.15/64/0
47	24/510/1/150/14/0.15/64/90
48	24/510/2/16/14/0.15/64/0
49	24/510/3/16/14/0.15/64/180
50	24/610/1/42/14/0.15/64/90
51	24/610/2/25/14/0.15/64/180
52	24/610/3/42/14/0.15/64/270
53	25/130/1///100/1.1/0.9
54	25/320/1///100/1.1/0.9
55	25/320/2///100/1.1/0.9
56	25/320/3///100/1.1/0.9
57	25/320/4///100/1.1/0.9
58	25/320/5///100/1.1/0.9

LINE # -----

59 25/330/1///100/1.1/0.9

60 25/510/1/23/10/1/1.1/0.9

61 25/610/1/4/10/1/1.1/0.9

62 26/M/1395PLP/1395LT/AVAIL/AVAIL//AVAIL

63 27/M/50/SF-PERS/350/325/3.0/WATT-SF/ASHRAE2/1.25/15

64 28/M/1/MISC EQUIPMENT/2.0/WATT-SF//ELEC/80

65 28/110/1/MISC EQUIPMENT/5/WATT-SF//ELEC/80

66 28/300/1/MISC EQUIPMENT/.5/WATT-SF//ELEC/80

67 28/610/1/MISC EQUIPMENT/.5/WATT-SF//ELEC/80

68 29/M110/25/CFM-P/25/CFM-P/0.1/ACH-HR/0.1/ACH-HR

69 29/M210/25/CFM-P/25/CFM-P/0.1/ACH-HR/0.1/ACH-HR

70 29/M300/25/CFM-P/25/CFM-P/0.1/ACH-HR/0.1/ACH-HR/35/PCT-MCLG

71 30/M/1.75/CFM-SF

72 32/110/1/86/0.8

73 32/120/1/60/0.8

74 32/130/1/19/0.8

75 32/210/1/88/0.8

76 32/300/1/78/0.8

77 32/320/1/60/0.8

78 32/330/1/44/0.8

79 32/510/1/182/0.8

80 32/610/1/109/0.8

81 SYSTEM - 1

82 39/1/AS-BUILT CONDITIONS

83 40/1/BPM2

84 41/1/11/13

85 42/1/3.0/3/////RETAIR///OTHER/DUCTED

86 43/1/53/53

87 45/1/AVAIL

88 47/1//////////BLOW

89 40/2/VTCV

90 41/2/21/21

91 42/2/3.0/3////////OTHER/DUCTED

92 43/2/57.5/57.5

93 45/2/AVAIL

94 40/3/BPM2

95 41/3/30/33

96 42/3/3.0/3/////RETAIR///OTHER/DUCTED

97 43/3/59/59

98 45/3/AVAIL

99 47/3//////////BLOW

100 40/4/VTCV

101 41/4/41/41

102 42/4/2.0/2////////OTHER/DUCTED

103 43/4/57.5/57.5

104 45/4/AVAIL

105 40/5/VTCV

106 41/5/51/51

107 42/5/2.0/2////////OTHER/DUCTED

108 43/5/57.5/57.5

109 45/5/AVAIL

110 40/6/VTCV

111 41/6/61/61

112 42/6/2.0/2////////OTHER/DUCTED

113 43/6/58.5/58.5

114 45/6/AVAIL

115 EQUIPMENT - 1

116 60/1/1/BLKPLANT/1/2

LINE #	
117	60/2/2/BLKPLANT/3/6
118	62/1/EQ1100L/1/80/TONS/1.33/KW-TON
119	62/2/EQ1001S/1/160/TONS/1.04/KW-TON
120	63/1/7.5/HP
121	63/2/11.5/HP/15/HP/////1
122	65/1/1/1/2
123	65/2/2/3/6
124	67/1/EQ2001/1/7.5/HP///80/PCTEFF
125	67/2/EQ2001/1/.75/HP///80/PCTEFF///2
126	69/1/EQ4003/EQ4003
127	69/2/EQ4003
128	69/3/EQ4001
129	69/4/EQ4003
130	69/5/EQ4003
131	69/6/EQ4003
132	70/1/13.01
133	70/2/1.89
134	70/3/17.15
135	70/4/1.45
136	70/5/1.45
137	70/6/1.0
138	SYSTEM - 2
139	39/2/AS-BUILT CONDITIONS WITH STOP-START
140	40/1/BPMZ
141	41/1/11/13
142	42/1/3.0/3/////RETAIR///OTHER/DUCTED
143	43/1/53/53
144	45/1/1395C
145	47/1/////BLOW
146	40/2/VTCV
147	41/2/21/21
148	42/2/3.0/3/////OTHER/DUCTED
149	43/2/57.5/57.5
150	45/2/1395C
151	40/3/BPMZ
152	41/3/30/33
153	42/3/3.0/3/////RETAIR///OTHER/DUCTED
154	43/3/59/59
155	45/3/1395C
156	47/3/////BLOW
157	40/4/VTCV
158	41/4/41/41
159	42/4/2.0/2/////OTHER/DUCTED
160	43/4/57.5/57.5
161	45/4/1395C
162	40/5/VTCV
163	41/5/51/51
164	42/5/2.0/2/////OTHER/DUCTED
165	43/5/57.5/57.5
166	45/5/1395C
167	40/6/VTCV
168	41/6/61/61
169	42/6/2.0/2/////OTHER/DUCTED
170	43/6/58.5/58.5
171	45/6/1395C
172	EQUIPMENT - 2
173	60/1/1/BLKPLANT/1/2
174	60/2/2/BLKPLANT/3/6



LINE # -----

175 62/1/EQ1100L/1/80/TONS/1.33/KW-TON

176 62/2/EQ1001S/1/160/TONS/1.04/KW-TON

177 63/1/7.5/HP

178 63/2/11.5/HP/15/HP/////1

179 65/1/1//1/2

180 65/2/2//3/6

181 67/1/EQ2001/1/7.5/HP///80/PCTEFF

182 67/2/EQ2001/1/.75/HP///80/PCTEFF////2

183 69/1/EQ4003/EQ4003

184 69/2/EQ4003

185 69/3/EQ4001

186 69/4/EQ4003

187 69/5/EQ4003

188 69/6/EQ4003

189 70/1/13.01

190 70/2/1.89

191 70/3/17.15

192 70/4/1.45

193 70/5/1.45

194 70/6/1.0

195 SYSTEM - 3

196 39/3/NEW CHILLER WITH STOP-START

197 40/1/BPM2

198 41/1/11/13

199 42/1/3.0/3/////RETAIR///OTHER/DUCTED

200 43/1/53/53

201 45/1/1395C

202 47/1//////////BLOW

203 40/2/VTCV

204 41/2/21/21

205 42/2/3.0/3////////OTHER/DUCTED

206 43/2/57.5/57.5

207 45/2/1395C

208 40/3/BPM2

209 41/3/30/33

210 42/3/3.0/3/////RETAIR///OTHER/DUCTED

211 43/3/59/59

212 45/3/1395C

213 47/3//////////BLOW

214 40/4/VTCV

215 41/4/41/41

216 42/4/2.0/2////////OTHER/DUCTED

217 43/4/57.5/57.5

218 45/4/1395C

219 40/5/VTCV

220 41/5/51/51

221 42/5/2.0/2////////OTHER/DUCTED

222 43/5/57.5/57.5

223 45/5/1395C

224 40/6/VTCV

225 41/6/61/61

226 42/6/2.0/2////////OTHER/DUCTED

227 43/6/58.5/58.5

228 45/6/1395C

229 EQUIPMENT - 3

230 60/1/1/BLKPLANT/1/6

231 62/1/EQ1001S/1/234/TONS/.632/KW-TON

232 63/1/25/HP/15/HP

CONTENTS OF : H:\JOB\911099\12F\HVAC\TRACE\B1395.TM

LINE #	
233	65/1/1//1/6
234	67/1/EQ2001/1/7.5/HP///80/PCTEFF
	67/2/EQ2001/1/.75/HP///80/PCTEFF///2
	69/1/EQ4003/EQ4003
237	69/2/EQ4003
238	69/3/EQ4001
239	69/4/EQ4003
240	69/5/EQ4003
241	69/6/EQ4003
242	70/1/13.01
243	70/2/1.89
244	70/3/17.15
245	70/4/1.45
246	70/5/1.45
247	70/6/1.0

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TRACE 600 ANALYSIS \*\*  
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by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
EEAP ALTERNATIVES

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 74 (F)  
Winter Design Dry Bulb: 29 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 14:26:11 4/17/94  
Dataset Name: B1395 .TM

AIRFLOW - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	BPMZ	4,577	16,796	16,796	16,949	4,730	0	0
2	VTCV	944	3,302	3,302	3,334	975	0	0
3	BPMZ	7,229	26,084	26,084	26,325	7,470	0	0
4	VTCV	1,530	5,355	5,355	5,406	1,581	0	0
5	VTCV	1,472	5,152	5,152	5,201	1,521	0	0
6	VTCV	525	1,837	1,838	1,855	542	0	0
Totals		16,277	58,527	58,527	59,069	16,820	0	0

CAPACITY - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

		Cooling				Heating						
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
	1 BPMZ	61.9	0.0	0.0	61.9	-234,377	0	0	0	0	0	-234,377
	2 VTCV	11.2	0.0	0.0	11.2	-50,285	0	0	0	0	0	-50,285
	3 BPMZ	79.5	0.0	0.0	79.5	-407,841	0	0	0	0	0	-407,841
	4 VTCV	17.7	0.0	0.0	17.7	-69,699	0	0	0	0	0	-69,699
	5 VTCV	17.4	0.0	0.0	17.4	-96,956	0	0	0	0	0	-96,956
	6 VTCV	5.9	0.0	0.0	5.9	-37,483	0	0	0	0	0	-37,483
Totals		193.6	0.0	0.0	193.6	-896,640	0	0	0	0	0	-896,640

The building peaked at hour 13 month 8 with a capacity of 193.6 tons

ENGINEERING CHECKS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	----- Cooling -----				--- Heating ---		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	BPMZ	27.25	1.83	271.5	148.0	81.10	1.83	-25.60	9,155
2	Main	VTCV	28.57	1.75	295.1	168.6	71.17	1.75	-26.65	1,887
3	Main	BPMZ	27.71	1.80	328.0	181.8	66.00	1.80	-28.21	14,458
4	Main	VTCV	28.57	1.75	302.2	172.7	69.48	1.75	-22.78	3,060
5	Main	VTCV	28.57	1.75	295.4	168.8	71.09	1.75	-32.93	2,944
6	Main	VTCV	28.57	1.75	312.6	178.6	67.17	1.75	-35.70	1,050

System 1 Block BPMZ - BYPASS MULTIZONE

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
 Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 8/14 \* Mo/Hr: 13/ 1  
 Outside Air ==> OADB/WB/HR: 95/ 76/111.1 \* OADB: 95 \* OADB: 29

	Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct		Space Peak	Coil Peak	Perct
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads												
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	39,522		39,522	5.32	*	0	0.00	*	0	-21,001	8.96
Glass Solar	12,236	0		12,236	1.65	*	32,186	7.09	*	0	0	0.00
Glass Cond	4,272	0		4,272	0.58	*	-2,136	-0.47	*	-13,196	-13,196	5.63
Wall Cond	3,452	-96		3,356	0.45	*	3,833	0.84	*	-8,979	-11,850	5.06
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-5,412	-5,412	2.31
Infiltration	7,080			7,080	0.95	*	2,279	0.50	*	-6,767	-6,767	2.89
Sub Total==>	27,040	39,426		66,466	8.95	*	36,163	7.96	*	-34,355	-58,227	24.84
Internal Loads												
Lights	60,854	10,739		71,592	9.64	*	62,084	13.67	*	0	0	0.00
People	70,503			70,503	9.50	*	47,163	10.38	*	0	0	0.00
Misc	90,670	0	0	90,670	12.21	*	72,536	15.97	*	0	0	0.00
Sub Total==>	222,026	10,739	0	232,765	31.35	*	181,783	40.02	*	0	0	0.00
Ceiling Load	39,977	-39,977		0	0.00	*	38,884	8.56	*	-23,872	0	0.00
Outside Air	0	0	0	212,410	28.61	*	0	0.00	*	0	-203,024	86.62
Sup. Fan Heat				26,874	3.62	*		0.00	*		26,874	-11.47
Ret. Fan Heat		8,958		8,958	1.21	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	197,419			197,419	26.59	*	197,419	43.46	*	0	0	0.00
Exhaust Heat		-2,441	0	-2,441	-0.33	*		0.00	*		0	0.00
Minimal Bypass		0	0	0	-0.00	*		0.00	*		0	0.00
Grand Total==>	486,462	16,705	0	742,451	100.00	*	454,248	100.00	*	-58,227	-234,377	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	61.9	742.5	558.6	16,796	83.5	68.1	81.7	51.9	50.9	55.6	9,155	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	165	
Totals	61.9	742.5									9,155	
											2,310	266 12

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent			Clg Cfm/Sqft			SADB	53.0	73.2
Main Htg	-234.4	16,796	60.3	73.2	Infil	153	153	Clg Cfm/Ton	271.48		Plenum	91.8	61.8
Aux Htg	0.0	0	0.0	0.0	Supply	16,796	16,796	Clg Sqft/Ton	147.97		Return	78.5	70.0
Preheat	-0.0	16,796	60.3	53.0	Mincfm	0	0	Clg Btuh/Sqft	81.10		Ret/OA	83.1	58.8
Reheat	0.0	0	0.0	0.0	Return	16,796	16,796	No. People	183		Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	4,577	4,577	Htg % OA	27.3		Fn MtrTD	0.5	0.5
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/SqFt	1.83		Fn BldTD	0.4	0.4
Total	-234.4				Auxil	0	0	Htg Btuh/SqFt	-25.60		Fn Frict	1.1	1.1

System 2 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 92			OADB: 29		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	5,958		5,958	4.44	0	0.00	0	-4,137	8.23
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	2,086	106		2,191	1.63	2,759	3.77	-5,412	-7,065	14.05
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-2,886	-2,886	5.74
Infiltration	1,475			1,475	1.10	493	0.67	-1,395	-1,395	2.77
Sub Total==>	3,560	6,064		9,624	7.17	3,252	4.44	-9,693	-15,483	30.79
*****										
Internal Loads										
Lights	12,382	2,185		14,567	10.85	12,865	17.57	0	0	0.00
People	17,351			17,351	12.92	9,907	13.53	0	0	0.00
Misc	12,881	0	0	12,881	9.59	10,305	14.07	0	0	0.00
Sub Total==>	42,614	2,185	0	44,799	33.36	33,076	45.17	0	0	0.00
Ceiling Load	8,249	-8,249		0	0.00	8,318	11.36	-5,790	0	0.00
Outside Air	0	0	0	44,242	32.94	0	0.00	0	-41,847	83.22
Sup. Fan Heat				7,045	5.25		0.00		7,045	-14.01
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	28,587			28,587	21.29	28,587	39.04	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	83,010	0	0	134,296	100.00	73,232	100.00	-15,483	-50,285	100.00

-----COOLING COIL SELECTION-----

	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
				Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	11.2	134.3	3,302	81.8	67.9	83.1	55.5	54.8	64.9	1,887	0	
Aux Clg	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Part	0	
Opt Vent	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	88	
Totals	11.2	134.3								Roof	1,887	0 0
										Wall	1,232	0 0

-----HEATING COIL SELECTION-----

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	--ENGINEERING CHECKS--			--TEMPERATURES (F)--		
								Clg % OA	28.6		Type	Clg	Htg
Main Htg	-50.3	3,302	58.3	72.4	Vent	944	944	Clg Cfm/Sqft	1.75		SADB	57.5	74.3
Aux Htg	0.0	0	0.0	0.0	Infil	31	31	Clg Cfm/Ton	295.07		Plenum	91.8	60.3
Preheat	-0.0	3,302	58.3	55.5	Supply	3,302	3,302	Clg Sqft/Ton	168.61		Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	0	0	Clg Btuh/Sqft	71.17		Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	Return	3,302	3,302	No. People	38		Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	944	944	Htg % OA	28.6		Fn MtrTD	0.5	0.5
Total	-50.3				Rm Exh	0	0	Htg Cfm/Sqft	1.75		Fn BldTD	0.4	0.4
					Auxil	0	0	Htg Btuh/Sqft	-26.65		Fn Frict	1.1	1.1

System 3 Block BPMZ - BYPASS MULTIZONE

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****					***** HEATING COIL PEAK *****				
Peaked at Time ==>					Mo/Hr: 8/14					Mo/Hr: 7/18				
Outside Air ==>					OADB/WB/HR: 95/ 76/111.1					OADB: 92				
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak (Btuh)	Coil Peak (Btuh)	Perct Of Tot (%)	Space Sens (Btuh)	Coil Peak (Btuh)	Perct Of Tot (%)	
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00	0	0	0.00	
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00	0	0	0.00	
Roof Cond	0	61,082		61,082	6.40	0	0.00	0	-33,704	8.26	0	-33,704	8.26	
Glass Solar	42,112	0		42,112	4.41	52,528	9.80	0	0	0.00	0	0	0.00	
Glass Cond	23,383	0		23,383	2.45	21,917	4.09	-72,232	-72,232	17.71	-72,232	-72,232	17.71	
Wall Cond	1,603	-70		1,533	0.16	1,697	0.32	-4,797	-6,356	1.56	-4,797	-6,356	1.56	
Partition	0			0	0.00	0	0.00	0	0	0.00	0	0	0.00	
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00	0	0	0.00	
Infiltration	10,238			10,238	1.07	3,858	0.72	-5,970	-5,970	1.46	-5,970	-5,970	1.46	
Sub Total==>	77,336	61,012		138,348	14.50	80,000	14.92	-10,688	-10,688	2.62	-10,688	-10,688	2.62	
Internal Loads														
Lights	96,103	16,959		113,062	11.85	98,463	18.37	0	0	0.00	0	0	0.00	
People	111,037			111,037	11.64	73,321	13.68	0	0	0.00	0	0	0.00	
Misc	61,953	0	0	61,953	6.49	49,562	9.24	0	0	0.00	0	0	0.00	
Sub Total==>	269,093	16,959	0	286,052	29.98	221,346	41.29	0	0	0.00	0	0	0.00	
Ceiling Load	69,613	-69,613		0	0.00	63,871	11.91	-35,263	0	0.00	-35,263	0	0.00	
Outside Air	0	0	0	307,136	32.19	0	0.00	0	-320,625	78.62	0	-320,625	78.62	
Sup. Fan Heat				41,734	4.37		0.00		41,734	-10.23		41,734	-10.23	
Ret. Fan Heat		13,911		13,911	1.46		0.00		0	0.00		0	0.00	
Duct Heat PkUp		0		0	0.00		0.00		0	0.00		0	0.00	
OV/UNDR Sizing	170,896			170,896	17.91	170,896	31.88	0	0	0.00	0	0	0.00	
Exhaust Heat		-3,855	0	-3,855	-0.40		0.00		0	0.00		0	0.00	
Minimal Bypass		0	0	0	-0.00		0.00		0	0.00		0	0.00	
Grand Total==>	586,938	18,414	0	954,222	100.00	536,113	100.00	-128,949	-407,841	100.00	-128,949	-407,841	100.00	

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	79.5	954.2	709.4	26,084	Deg F	Deg F	Grains	Deg F	Deg F	Floor	14,458	
Aux Clg	0.0	0.0	0.0	0	83.6	68.9	86.0	57.9	57.3	Part	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	ExFlr	182	
Totals	79.5	954.2			0.0	0.0	0.0	0.0	0.0	Roof	14,458	0 0
										Wall	2,548	1,456 57

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating		Clg % OA	27.7	Type	Clg	Htg
Main Htg	-407.8	26,084	60.1	Vent	7,229	7,229		Clg Cfm/Sqft	1.80	SADB	59.0	74.6
Aux Htg	0.0	0	0.0	Infil	241	241		Clg Cfm/Ton	328.02	Plenum	93.2	62.3
Preheat	-0.0	26,084	60.1	Supply	26,084	26,084		Clg Sqft/Ton	181.82	Return	78.5	70.0
Reheat	0.0	0	0.0	Mincfm	9,129	9,129		Clg Btuh/Sqft	66.00	Ret/OA	83.2	58.6
Humidif	0.0	0	0.0	Return	26,084	26,084		No. People	289	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	Exhaust	7,229	7,229		Htg % OA	27.7	Fn MtrTD	0.5	0.5
Total	-407.8			Rm Exh	0	0		Htg Cfm/SqFt	1.80	Fn BldTD	0.4	0.4
				Auxil	0	0		Htg Btuh/SqFt	-28.21	Fn Frict	1.1	1.1



System 4 Peak VTCV - VARIABLE TEMP CONSTANT VOL

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 7/18 \* Mo/Hr: 13/ 1 \*  
Outside Air ==> OADB/WB/HR: 95/ 76/111.1 \* OADB: 92 \* OADB: 29 \*

	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)		Space Sensible (Btuh)	Perct Of Tot (%)		Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Envelope Loads												
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	12,596		12,596	5.92	*	0	0.00	*	0	-7,193	10.32
Glass Solar	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Glass Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Wall Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	2,365			2,365	1.11	*	799	0.67	*	-2,262	-2,262	3.25
Sub Total==>	2,365	12,596		14,962	7.04	*	799	0.67	*	-2,262	-9,455	13.57
Internal Loads												
Lights	20,340	3,589		23,929	11.25	*	21,122	17.79	*	0	0	0.00
People	23,501			23,501	11.05	*	16,065	13.53	*	0	0	0.00
Misc	20,888	0	0	20,888	9.82	*	16,710	14.07	*	0	0	0.00
Sub Total==>	64,728	3,589	0	68,318	32.13	*	53,897	45.39	*	0	0	0.00
Ceiling Load	16,186	-16,186		0	0.00	*	13,299	11.20	*	-7,193	0	0.00
Outside Air	0	0	0	70,963	33.38	*	0	0.00	*	0	-67,860	97.36
Sup. Fan Heat				7,616	3.58	*		0.00	*		7,616	-10.93
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	50,759			50,759	23.87	*	50,759	42.74	*	0	0	0.00
Exhaust Heat		0	0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	134,039	0	0	212,618	100.00	*	118,754	100.00	*	-9,455	-69,699	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	17.7	212.6	153.1	5,355	83.0	68.0	82.2	56.2	55.5	66.7	Floor	3,060
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Part	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	0
Totals	17.7	212.6									Roof	3,060
											Wall	0

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)--		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating		Clg % OA	28.6	Type	Clg	Htg
Main Htg	-69.7	5,355	58.3	70.3	Vent	1,530	1,530	Clg Cfm/Sqft	1.75	SADB	57.5	71.6
Aux Htg	0.0	0	0.0	0.0	Infil	51	51	Clg Cfm/Ton	302.23	Plenum	94.7	62.6
Preheat	-0.0	5,355	58.3	56.2	Supply	5,355	5,355	Clg Sqft/Ton	172.70	Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	1,874	1,874	Clg Btuh/Sqft	69.48	Ret/OA	83.0	58.3
Humidif	0.0	0	0.0	0.0	Return	5,355	5,355	No. People	61	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	1,530	1,530	Htg % OA	28.6	Fn MtrTD	0.3	0.3
Total	-69.7				Rm Exh	0	0	Htg Cfm/SqFt	1.75	Fn BldTD	0.2	0.2
					Auxil	0	0	Htg Btuh/SqFt	-22.78	Fn Frict	0.7	0.7

System 5 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peaked at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/13			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 95			OADB: 29		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	9,277		9,277	4.43	0	0.00	0	-6,315	6.51
Glass Solar	17,940	0		17,940	8.57	15,410	13.49	0	0	0.00
Glass Cond	2,758	0		2,758	1.32	3,441	3.01	-11,410	-11,410	11.77
Wall Cond	3,888	264		4,152	1.98	4,317	3.78	-9,779	-13,125	13.54
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-5,970	-5,970	6.16
Infiltration	2,283			2,283	1.09	883	0.77	-2,176	-2,176	2.24
Sub Total==>	26,868	9,541		36,409	17.40	24,051	21.05	-29,335	-38,996	40.22
Internal Loads										
Lights	19,318	3,409		22,727	10.86	19,318	16.91	0	0	0.00
People	27,261			27,261	13.03	12,777	11.18	0	0	0.00
Misc	20,096	0	0	20,096	9.60	16,077	14.07	0	0	0.00
Sub Total==>	66,675	3,409	0	70,084	33.49	48,172	42.16	0	0	0.00
Ceiling Load	12,950	-12,950		0	0.00	15,038	13.16	-9,661	0	0.00
Outside Air	0	0	0	68,479	32.72	0	0.00	0	-65,287	67.34
Sup. Fan Heat				7,327	3.50		0.00		7,327	-7.56
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat PkUp		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	26,993			26,993	12.90	26,993	23.63	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	133,486	0	0	209,292	100.00	114,252	100.00	-38,996	-96,956	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	17.4	209.3	141.3	5,152	81.8	67.9	56.2	55.0	64.9	Floor	2,944	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	Part	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	ExFlr	182	
Totals	17.4	209.3								Roof	2,944	0 0
										Wall	2,548	230 9

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----		-----TEMPERATURES (F)-----		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
Main Htg	-97.0	5,152	58.3	75.7	Vent	1,472	1,472	Clg % OA	28.6	SADB	57.5	77.0
Aux Htg	0.0	0	0.0	0.0	Infil	49	49	Clg Cfm/Sqft	1.75	Plenum	91.9	59.6
Preheat	-0.0	5,152	58.3	56.2	Supply	5,152	5,152	Clg Cfm/Ton	295.40	Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	1,803	1,803	Clg Sqft/Ton	168.80	Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	Return	5,152	5,152	Clg Btuh/Sqft	71.09	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	1,472	1,472	No. People	59	Fn MtrTD	0.3	0.3
Total	-97.0				Rm Exh	0	0	Htg % OA	28.6	Fn BldTD	0.2	0.2
					Auxil	0	0	Htg Cfm/Sqft	1.75	Fn Frict	0.7	0.7
								Htg Btuh/Sqft	-32.93			

System 6 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****		***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/12						Mo/Hr: 7/18		Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0						OADB: 92		OADB: 29		
Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct	Space Peak	Coil Peak	Perct
Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot	Space Sens	Tot Sens	Of Tot
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)	(Btuh)	(Btuh)	(%)
Envelope Loads										
Skylite Solr	0	0	0	0.00	*	0	0.00	0	0	0.00
Skylite Cond	0	0	0	0.00	*	0	0.00	0	0	0.00
Roof Cond	0	3,295	3,295	4.67	*	0	0.00	0	-2,126	5.67
Glass Solar	3,120	0	3,120	4.42	*	1,600	4.13	0	0	0.00
Glass Cond	480	0	480	0.68	*	594	1.53	-1,984	-1,984	5.29
Wall Cond	2,630	172	2,802	3.97	*	3,245	8.37	-6,457	-8,349	22.27
Partition	0		0	0.00	*	0	0.00	0	0	0.00
Exposed Floor	0		0	0.00	*	0	0.00	-3,575	-3,575	9.54
Infiltration	789		789	1.12	*	274	0.71	-776	-776	2.07
Sub Total==>	7,019	3,466	10,485	14.87	*	5,713	14.74	-12,793	-16,811	44.85
Internal Loads										
Lights	6,890	1,216	8,106	11.49	*	7,158	18.47	0	0	0.00
People	9,723		9,723	13.78	*	5,512	14.22	0	0	0.00
Misc	1,792	0	1,792	2.54	*	1,433	3.70	0	0	0.00
Sub Total==>	18,405	1,216	19,621	27.82	*	14,104	36.39	0	0	0.00
Ceiling Load	4,682	-4,682	0	0.00	*	4,792	12.36	-4,018	0	0.00
Outside Air	0	0	23,662	33.55	*	0	0.00	0	-23,285	62.12
Sup. Fan Heat			2,613	3.71	*		0.00		2,613	-6.97
Ret. Fan Heat		0	0	0.00	*		0.00		0	0.00
Duct Heat PkUp		0	0	0.00	*		0.00		0	0.00
OV/UNDR Sizing	14,152		14,152	20.06	*	14,152	36.51	0	0	0.00
Exhaust Heat		0	0	0.00	*		0.00		0	0.00
Minimal Bypass		0	0	0.00	*		0.00		0	0.00
Grand Total==>	44,258	0	0	70,533	100.00	38,761	100.00	-16,811	-37,483	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR				Gross Total	Glass (sf)	(%)
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	5.9	70.5	1,837	81.8	68.2	85.0	57.2	56.2	68.1	Part	0	
Aux Clg	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	109	
Opt Vent	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Roof	1,050	0 0
Totals	5.9	70.5								Wall	1,526	40 3

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating		Clg % OA	28.6	Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F	Vent	525	525		Clg Cfm/Sqft	1.75	SADB	58.5	78.5
Main Htg	-37.5	1,838	58.3	77.1	Infil	18		Clg Cfm/Ton	312.62	Plenum	92.1	57.9
Aux Htg	0.0	0	0.0	0.0	Supply	1,837	1,838	Clg Sqft/Ton	178.64	Return	78.0	70.0
Preheat	-0.0	1,837	58.3	57.2	Mincfm	643	643	Clg Btuh/Sqft	67.17	Ret/OA	81.8	58.3
Reheat	0.0	0	0.0	0.0	Return	1,837	1,838	No. People	21	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	525	525	Htg % OA	28.6	Fn MtrTD	0.3	0.3
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/SqFt	1.75	Fn BldTD	0.2	0.2
Total	-37.5			Auxil	0	0		Htg Btuh/SqFt	-35.70	Fn Frict	0.7	0.7



MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Thrm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	116,013	306	282	3	3
Feb	104,732	292	334	2	3
March	151,018	318	88	31	1
April	167,217	343	14	60	0
May	192,471	366	0	89	0
June	199,377	380	0	110	0
July	213,154	400	0	131	0
Aug	218,128	406	0	137	0
Sept	197,447	380	0	105	0
Oct	162,718	342	67	49	1
Nov	140,908	325	115	28	1
Dec	126,077	307	380	5	3
Total	1,989,258	406	1,279	751	3

Building Energy Consumption = 212,484 (Btu/Sq Ft/Year)  
Source Energy Consumption = 629,866 (Btu/Sq Ft/Year)

Floor Area = 32,554 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

----- EQUIPMENT ENERGY CONSUMPTION -----														
Ref	Equip	Monthly Consumption												Total
Num	Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	30601	28153	33049	30601	31825	31825	30601	33049	30601	31825	28153	30601	370,881
	PK	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6
1	MISC LD													
	ELEC	45403	41009	45403	43938	45403	43938	45403	45403	43938	45403	43938	45403	534,579
	PK	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1100L	AIR-CLD RECIP >45 TONS												
	ELEC	3961	3061	13116	19518	25930	30024	35358	36735	30008	18291	13301	5858	235,160
	PK	37.5	37.5	40.4	49.1	58.6	65.2	72.3	74.2	64.9	50.3	43.1	37.5	74.2
1	EQ5200	CONDENSER FANS												
	ELEC	171	122	758	1401	1981	2387	3369	3038	2428	1300	770	258	17,982
	PK	1.0	1.0	3.1	4.2	5.1	5.6	10.5	10.5	5.8	4.4	3.3	1.7	10.5
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	2379	2185	4847	5369	5548	5369	5548	5548	5369	5362	4728	2565	54,817
	PK	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
1	EQ5303	CONTROLS												
	ELEC	96	88	195	216	223	216	223	223	216	216	190	103	2,205
	PK	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2	EQ1001S	2-STG CTV <555 TONS												
	ELEC	983	777	9515	16955	25107	30192	35378	36857	29461	13431	8396	1806	208,857
	PK	26.4	26.4	34.4	48.5	60.5	67.9	76.6	80.4	67.9	45.7	36.9	26.4	80.4
	EQ5100	COOLING TOWER												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

ELEC	1026	0	5337	7731	9907	9852	10181	10181	9852	6445	4693	2573	77,777
PK	13.7	0.0	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
2 EQ5100	COOLING TOWER												
WATER	3	2	31	60	89	110	131	137	105	49	28	5	751
PK	0.0	0.0	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.1	0.0	0.3
2 EQ5001	CHILLED WATER PUMP C.V.												
ELEC	1475	1315	4459	6460	8278	8233	8507	8507	8233	5385	3922	2687	67,461
PK	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
2 EQ5010	CONDENSER WATER PUMP C.V.												
ELEC	1924	1715	5816	8426	10798	10738	11096	11096	10738	7025	5116	3505	87,993
PK	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
2 EQ5300	CONTROL PANEL & INTERLOCK												
ELEC	129	115	390	565	724	720	744	744	720	471	343	235	5,900
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	9679	8743	9679	9367	9679	9367	9679	9679	9367	9679	9367	9679	113,968
PK	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1406	1270	1406	1361	1406	1361	1406	1406	1361	1406	1361	1406	16,556
PK	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
3 EQ4001	AIRFOIL CENTRIF. FAN C.V.												
ELEC	12760	11525	12760	12348	12760	12348	12760	12760	12348	12760	12348	12760	150,234
PK	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
4 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
PK	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
5 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
6 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	744	672	744	720	744	720	744	744	720	744	720	744	8,760
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	5	40	13	0	0	0	0	0	0	7	14	78	157
PK	0.6	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.6
1 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	380	1260	902	37	0	0	0	0	0	455	917	2759	6,711
PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5
EQ5240	BOILER FORCED DRAFT FAN												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	ELEC	15	48	34	1	0	0	0	0	0	17	35	105	256
	PK	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3
1	EQ5307	BOILER CONTROLS												
	ELEC	25	84	61	3	0	0	0	0	0	30	62	185	450
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5
2	EQ2001	GAS FIRE TUBE HOT WATER												
	GAS	277	294	74	13	0	0	0	0	0	60	101	302	1,121
	PK	2.8	2.9	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.6	0.7	2.2	2.9
2	EQ5020	HEAT WATER CIRC. PUMP C.V.												
	ELEC	280	257	157	45	0	0	0	0	0	127	185	276	1,327
	PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7
2	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	230	211	129	37	0	0	0	0	0	104	152	226	1,089
	PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6
2	EQ5307	BOILER CONTROLS												
	ELEC	188	173	105	30	0	0	0	0	0	85	124	185	890
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5



UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 406.5 (kW)  
Yearly Time of Peak 14 (hr) 8 (mo)  
Hour 14 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
Cooling Equipment				
1	EQ1100L	AIR-CLD RECIP >45 TONS	92.5	22.75
2	EQ1001S	2-STG CTV <555 TONS	121.4	29.87
Sub Total			213.9	52.62
Sub Total			0.0	0.00
Air Moving Equipment				
1	SUMMATION OF FAN ELECTRICAL DEMAND		13.0	3.20
2	SUMMATION OF FAN ELECTRICAL DEMAND		1.9	0.46
3	SUMMATION OF FAN ELECTRICAL DEMAND		17.1	4.22
	SUMMATION OF FAN ELECTRICAL DEMAND		1.4	0.36
	SUMMATION OF FAN ELECTRICAL DEMAND		1.5	0.36
6	SUMMATION OF FAN ELECTRICAL DEMAND		1.0	0.25
Sub Total			36.0	8.84
Sub Total			0.0	0.00
Miscellaneous				
Lights			95.6	23.53
Base Utilities			0.0	0.00
Misc Equipment			61.0	15.01
Sub Total			156.7	38.54
Grand Total			406.5	100.00

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TRACE 600 ANALYSIS \*\*  
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by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
EEAP ALTERNATIVES

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 74 (F)  
Winter Design Dry Bulb: 29 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 8:22:11 4/18/94  
Dataset Name: B1395 .TM

AIRFLOW - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	BPMZ	4,577	16,774	16,774	16,926	4,730	0	0
2	VTCV	944	3,302	3,302	3,334	975	0	0
3	BPMZ	7,229	25,835	25,835	26,076	7,470	0	0
4	VTCV	1,530	5,355	5,355	5,406	1,581	0	0
5	VTCV	1,472	5,152	5,152	5,201	1,521	0	0
6	VTCV	525	1,837	1,838	1,855	542	0	0
Totals		16,277	58,255	58,255	58,798	16,820	0	0

CAPACITY - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

System Number	System Type	Cooling					Heating						
		Main Sys. Capacity (Tons)	Aux. Sys. Capacity (Tons)	Sys. Opt. Capacity (Tons)	Vent Capacity (Tons)	Cooling Totals (Tons)	Main Sys. Capacity (Btuh)	Aux. Sys. Capacity (Btuh)	Preheat Capacity (Btuh)	Reheat Capacity (Btuh)	Humidif. Capacity (Btuh)	Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	BPMZ	61.4	0.0	0.0	0.0	61.4	-234,413	0	0	0	0	0	-234,413
2	VTCV	11.2	0.0	0.0	0.0	11.2	-50,285	0	0	0	0	0	-50,285
3	BPMZ	78.9	0.0	0.0	0.0	78.9	-408,239	0	0	0	0	0	-408,239
4	VTCV	17.8	0.0	0.0	0.0	17.8	-69,699	0	0	0	0	0	-69,699
5	VTCV	17.4	0.0	0.0	0.0	17.4	-96,956	0	0	0	0	0	-96,956
6	VTCV	5.9	0.0	0.0	0.0	5.9	-37,483	0	0	0	0	0	-37,483
Totals		192.6	0.0	0.0	0.0	192.6	-897,074	0	0	0	0	0	-897,074

The building peaked at hour 13 month 8 with a capacity of 192.6 tons

ENGINEERING CHECKS - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	----- Cooling -----				--- Heating ---		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	BPMZ	27.29	1.83	273.4	149.2	80.42	1.83	-25.60	9,155
2	Main	VTCV	28.57	1.75	294.7	168.4	71.26	1.75	-26.65	1,887
3	Main	BPMZ	27.98	1.79	327.6	183.3	65.45	1.79	-28.24	14,458
4	Main	VTCV	28.57	1.75	301.3	172.2	69.70	1.75	-22.78	3,060
5	Main	VTCV	28.57	1.75	295.4	168.8	71.09	1.75	-32.93	2,944
6	Main	VTCV	28.57	1.75	310.6	177.5	67.61	1.75	-35.70	1,050

System 1 Block BPMZ - BYPASS MULTIZONE

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 8/14 \* Mo/Hr: 13/ 1  
Outside Air ==> OADB/WB/HR: 95/ 76/111.1 \* OADB: 95 \* OADB: 29

	Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct		Space Peak	Coil Peak	Perct
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads												
Skylite Solr	0	0		0	0.00		0	0.00		0	0	0.00
Skylite Cond	0	0		0	0.00		0	0.00		0	0	0.00
Roof Cond	0	40,114		40,114	5.45		0	0.00		0	-21,001	8.96
Glass Solar	12,236	0		12,236	1.66		32,186	7.11		0	0	0.00
Glass Cond	4,272	0		4,272	0.58		-2,136	-0.47		-13,196	-13,196	5.63
Wall Cond	3,452	-1,645		1,807	0.25		3,833	0.85		-8,979	-11,850	5.06
Partition	0			0	0.00		0	0.00		0	0	0.00
Exposed Floor	0			0	0.00		0	0.00		-5,412	-5,412	2.31
Infiltration	6,974			6,974	0.95		2,279	0.50		-6,767	-6,767	2.89
Sub Total==>	26,933	38,470		65,403	8.88		36,163	7.99		-34,355	-58,227	24.84
Internal Loads												
Lights	41,432	7,312		48,744	6.62		42,270	9.34		0	0	0.00
People	70,503			70,503	9.58		47,163	10.42		0	0	0.00
Misc	90,670	0	0	90,670	12.31		72,536	16.03		0	0	0.00
Sub Total==>	202,605	7,312	0	209,917	28.51		161,969	35.78		0	0	0.00
Ceiling Load	37,295	-37,295		0	0.00		36,089	7.97		-23,872	0	0.00
Outside Air	0	0	0	209,207	28.41		0	0.00		0	-203,024	86.61
Sup. Fan Heat				26,838	3.65			0.00			26,838	-11.45
Ret. Fan Heat		8,946		8,946	1.22			0.00			0	0.00
Duct Heat Pkup		0		0	0.00			0.00			0	0.00
OV/UNDR Sizing	218,400			218,400	29.66		218,400	48.25		0	0	0.00
Exhaust Heat		-2,441	0	-2,441	-0.33			0.00			0	0.00
Terminal Bypass		0	0	0	-0.00			0.00			0	0.00
Grand Total==>	485,234	14,991	0	736,270	100.00		452,621	100.00		-58,227	-234,413	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	61.4	736.3	555.8	16,774	83.5	68.2	82.4	51.9	51.0	55.7	9,155	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	165	
Totals	61.4	736.3									9,155	0 0
											2,310	266 12

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----		-----TEMPERATURES (F)-----		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA		Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent							
Main Htg	-234.4	16,774	60.3	73.2	Infil	4,577	4,577	Clg Cfm/Sqft	27.3	SADB	53.1	73.2
Aux Htg	0.0	0	0.0	0.0	Supply	153	153	Clg Cfm/Ton	1.83	Plenum	90.9	61.8
Preheat	-0.0	16,774	60.3	53.1	Mincfm	16,774	16,774	Clg Sqft/Ton	273.38	Return	78.5	70.0
Reheat	0.0	0	0.0	0.0	Return	0	0	Clg Btuh/Sqft	149.21	Ret/OA	83.1	58.8
Humidif	0.0	0	0.0	0.0	Exhaust	16,774	16,774	No. People	80.42	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	4,577	4,577	Htg % OA	183	Fn MtrTD	0.5	0.5
Total	-234.4				Auxil	0	0	Htg Cfm/SqFt	27.3	Fn BldTD	0.4	0.4
								Htg Btuh/SqFt	1.83	Fn Frict	1.1	1.1
									-25.60			

System 2 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****					***** HEATING COIL PEAK *****				
Peak at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/18					Mo/Hr: 13/ 1				
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 92					OADB: 29				
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)				
Skyline Solr	0	0		0	0.00	0	0.00	0	0	0.00				
Skyline Cond	0	0		0	0.00	0	0.00	0	0	0.00				
Roof Cond	0	6,075		6,075	4.52	0	0.00	0	-4,137	8.23				
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00				
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00				
Wall Cond	2,086	153		2,238	1.66	2,759	3.77	-5,412	-7,065	14.05				
Partition	0			0	0.00	0	0.00	0	0	0.00				
Exposed Floor	0			0	0.00	0	0.00	-2,886	-2,886	5.74				
Infiltration	1,475			1,475	1.10	493	0.67	-1,395	-1,395	2.77				
Sub Total==>	3,560	6,228		9,789	7.28	3,252	4.44	-9,693	-15,483	30.79				
Internal Loads														
Lights	8,430	1,488		9,918	7.38	8,759	11.96	0	0	0.00				
People	17,351			17,351	12.90	9,907	13.53	0	0	0.00				
Misc	12,881	0	0	12,881	9.58	10,305	14.07	0	0	0.00				
Sub Total==>	38,662	1,488	0	40,150	29.86	28,970	39.56	0	0	0.00				
Ceiling Load	7,716	-7,716		0	0.00	7,764	10.60	-5,790	0	0.00				
Outside Air	0	0	0	44,242	32.90	0	0.00	0	-41,847	83.22				
Sup. Fan Heat				7,045	5.24		0.00		7,045	-14.01				
Ret. Fan Heat		0		0	0.00		0.00		0	0.00				
Duct Heat Pkup		0		0	0.00		0.00		0	0.00				
OV/UNDR Sizing	33,246			33,246	24.72	33,246	45.40	0	0	0.00				
Exhaust Heat		0	0	0	0.00		0.00		0	0.00				
Minimal Bypass		0	0	0	0.00		0.00		0	0.00				
Grand Total==>	83,184	0	0	134,471	100.00	73,232	100.00	-15,483	-50,285	100.00				

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	11.2	134.5	90.7	3,302	81.8	67.9	83.1	55.5	54.8	64.9	Floor	1,887
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Part	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	88
Totals	11.2	134.5									Roof	1,887
											Wall	1,232

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
Main Htg	-50.3	3,302	58.3	72.4	Vent	944	944	Clg Cfm/Sqft	1.75	SADB	57.5	74.3
Aux Htg	0.0	0	0.0	0.0	Infil	31	31	Clg Cfm/Ton	294.69	Plenum	90.9	60.3
Preheat	-0.0	3,302	58.3	55.5	Supply	3,302	3,302	Clg Sqft/Ton	168.39	Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	0	0	Clg Btuh/Sqft	71.26	Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	Return	3,302	3,302	No. People	38	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	944	944	Htg % OA	28.6	Fn MtrTD	0.5	0.5
Total	-50.3				Rm Exh	0	0	Htg Cfm/Sqft	1.75	Fn BldTD	0.4	0.4
					Auxil	0	0	Htg Btuh/Sqft	-26.65	Fn Frict	1.1	1.1

System 3 Block BPMZ - BYPASS MULTIZONE

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 7/18 \* Mo/Hr: 13/ 1 \*  
Outside Air ==> OADB/WB/HR: 95/ 76/111.1 \* OADB: 92 \* OADB: 29 \*

	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)		Space Sensible (Btuh)	Perct Of Tot (%)		Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Envelope Loads												
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	62,339		62,339	6.59	*	0	0.00	*	0	-33,704	8.26
Glass Solar	42,112	0		42,112	4.45	*	52,528	9.89	*	0	0	0.00
Glass Cond	23,383	0		23,383	2.47	*	21,917	4.13	*	-72,232	-72,232	17.69
Wall Cond	1,603	-12		1,591	0.17	*	1,697	0.32	*	-4,797	-6,356	1.56
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-5,970	-5,970	1.46
Infiltration	10,128			10,128	1.07	*	3,858	0.73	*	-10,688	-10,688	2.62
Sub Total==>	77,226	62,327		139,553	14.75	*	80,000	15.07	*	-93,686	-128,949	31.59
Internal Loads												
Lights	65,432	11,547		76,978	8.13	*	67,039	12.62	*	0	0	0.00
People	111,037			111,037	11.73	*	73,321	13.81	*	0	0	0.00
Misc	61,953	0	0	61,953	6.55	*	49,562	9.33	*	0	0	0.00
Sub Total==>	238,422	11,547	0	249,969	26.41	*	189,922	35.77	*	0	0	0.00
Ceiling Load	63,922	-63,922		0	0.00	*	59,367	11.18	*	-35,263	0	0.00
Outside Air	0	0	0	303,836	32.11	*	0	0.00	*	0	-320,625	78.54
Sup. Fan Heat				41,336	4.37	*		0.00	*		41,336	-10.13
Ret. Fan Heat		13,779		13,779	1.46	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	201,715			201,715	21.32	*	201,715	37.99	*	0	0	0.00
Exhaust Heat		-3,855	0	-3,855	-0.41	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	-0.00	*		0.00	*		0	0.00
Grand Total==>	581,285	19,875	0	946,332	100.00	*	531,003	100.00	*	-128,949	-408,239	100.00

-----COOLING COIL SELECTION-----

	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
				Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	78.9	946.3	25,835	83.6	69.0	86.6	57.9	57.3	71.7	Part	0	
Aux Clg	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	182	
Opt Vent	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Roof	14,458	0 0
Totals	78.9	946.3								Wall	2,548	1,456 57

-----HEATING COIL SELECTION-----

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	--ENGINEERING CHECKS--			--TEMPERATURES (F)--		
								Clg % OA	28.0		Type	Clg	Htg
Main Htg	-408.2	25,835	60.0	74.6	Vent	7,229	7,229	Clg Cfm/Sqft	1.79		SADB	59.0	74.6
Aux Htg	0.0	0	0.0	0.0	Infil	241	241	Clg Cfm/Ton	327.60		Plenum	92.0	62.3
Preheat	-0.0	25,835	60.0	59.0	Supply	25,835	25,835	Clg Sqft/Ton	183.34		Return	78.5	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	9,042	9,042	Clg Btuh/Sqft	65.45		Ret/OA	83.3	58.5
Humidif	0.0	0	0.0	0.0	Return	25,835	25,835	No. People	289		Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	7,229	7,229	Htg % OA	28.0		Fn MtrTD	0.5	0.5
Total	-408.2				Rm Exh	0	0	Htg Cfm/SqFt	1.79		Fn BldTD	0.4	0.4
					Auxil	0	0	Htg Btuh/SqFt	-28.24		Fn Frict	1.1	1.1

System 4 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 92			OADB: 29		
Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)	
Envelope Loads										
Skylite Solr	0	0	0	0.00	0	0.00	0	0	0.00	
Skylite Cond	0	0	0	0.00	0	0.00	0	0	0.00	
Roof Cond	0	9,873	9,873	4.63	0	0.00	0	-7,193	10.32	
Glass Solar	0	0	0	0.00	0	0.00	0	0	0.00	
Glass Cond	0	0	0	0.00	0	0.00	0	0	0.00	
Wall Cond	0	0	0	0.00	0	0.00	0	0	0.00	
Partition	0	0	0	0.00	0	0.00	0	0	0.00	
Exposed Floor	0	0	0	0.00	0	0.00	0	0	0.00	
Infiltration	2,343		2,343	1.10	799	0.67	-2,262	-2,262	3.25	
Sub Total==>	2,343	9,873	12,216	5.73	799	0.67	-2,262	-9,455	13.57	
Internal Loads										
Lights	13,316	2,350	15,666	7.35	14,381	12.11	0	0	0.00	
People	28,121		28,121	13.19	16,065	13.53	0	0	0.00	
Misc	20,888	0	20,888	9.79	16,710	14.07	0	0	0.00	
Sub Total==>	62,325	2,350	64,675	30.33	47,156	39.71	0	0	0.00	
Ceiling Load	12,223	-12,223	0	0.00	12,324	10.38	-7,193	0	0.00	
Outside Air	0	0	70,287	32.96	0	0.00	0	-67,860	97.36	
Sup. Fan Heat			7,616	3.57		0.00		7,616	-10.93	
Ret. Fan Heat		0	0	0.00		0.00		0	0.00	
Duct Heat PkUp		0	0	0.00		0.00		0	0.00	
OV/UNDR Sizing	58,475		58,475	27.42	58,475	49.24	0	0	0.00	
Exhaust Heat		0	0	0.00		0.00		0	0.00	
Terminal Bypass		0	0	0.00		0.00		0	0.00	
Grand Total==>	135,365	0	213,268	100.00	118,754	100.00	-9,455	-69,699	100.00	

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
			Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor			
Main Clg	17.8	213.3	143.6	5,355	81.8	68.0	84.1	56.2	55.5	66.7	3,060	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Totals	17.8	213.3									3,060	
											0	
											0	
											0	
											0	

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----			-----TEMPERATURES (F)-----		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA	28.6	Type	Clg	Htg		
				Vent	1,530	1,530	Clg Cfm/Sqft	1.75	SADB	57.5	71.6		
Main Htg	-69.7	5,355	58.3	Infil	51	51	Clg Cfm/Ton	301.31	Plenum	90.6	62.6		
Aux Htg	0.0	0	0.0	Supply	5,355	5,355	Clg Sqft/Ton	172.18	Return	78.0	70.0		
Preheat	-0.0	5,355	58.3	Mincfm	1,874	1,874	Clg Btuh/Sqft	69.70	Ret/OA	81.8	58.3		
Reheat	0.0	0	0.0	Return	5,355	5,355	No. People	61	Runarnd	78.0	70.0		
Humidif	0.0	0	0.0	Exhaust	1,530	1,530	Htg % OA	28.6	Fn MtrTD	0.3	0.3		
Opt Vent	0.0	0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	1.75	Fn BldTD	0.2	0.2		
Total	-69.7			Auxil	0	0	Htg Btuh/Sqft	-22.78	Fn Frict	0.7	0.7		



System 5 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peaked at Time ==> Mo/Hr: 8/12						Mo/Hr: 7/13			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0						OADB: 95			OADB: 29		
Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct		Space Peak	Coil Peak	Perct
Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads											
Skylite Solr	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	9,457	9,457	4.52	*	0	0.00	*	0	-6,315	6.51
Glass Solar	17,940	0	17,940	8.57	*	15,410	13.49	*	0	0	0.00
Glass Cond	2,758	0	2,758	1.32	*	3,441	3.01	*	-11,410	-11,410	11.77
Wall Cond	3,888	359	4,247	2.03	*	4,317	3.78	*	-9,779	-13,125	13.54
Partition	0	0	0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0	0	0	0.00	*	0	0.00	*	-5,970	-5,970	6.16
Infiltration	2,283	0	2,283	1.09	*	883	0.77	*	-2,176	-2,176	2.24
Sub Total==>	26,868	9,816	36,684	17.53	*	24,051	21.05	*	-29,335	-38,996	40.22
Internal Loads											
Lights	13,153	2,321	15,474	7.39	*	13,153	11.51	*	0	0	0.00
People	27,261	0	27,261	13.03	*	12,777	11.18	*	0	0	0.00
Misc	20,096	0	20,096	9.60	*	16,077	14.07	*	0	0	0.00
Sub Total==>	60,510	2,321	62,831	30.02	*	42,006	36.77	*	0	0	0.00
Ceiling Load	12,137	-12,137	0	0.00	*	14,225	12.45	*	-9,661	0	0.00
Outside Air	0	0	68,479	32.72	*	0	0.00	*	0	-65,287	67.34
Sup. Fan Heat			7,327	3.50	*		0.00	*		7,327	-7.56
Ret. Fan Heat		0	0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0	0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	33,971		33,971	16.23	*	33,971	29.73	*	0	0	0.00
Exhaust Heat		0	0	0.00	*		0.00	*		0	0.00
Terminal Bypass		0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	133,486	0	209,292	100.00	*	114,252	100.00	*	-38,996	-96,956	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor	2,944	
Main Clg	17.4	209.3	141.3	5,152	81.8	67.9	83.5	56.2	55.0	64.9	Part	0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	182
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Roof	2,944
Totals	17.4	209.3									Wall	2,548
												230
												9

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA	28.6	Type	Clg	Htg		
(Mbh)	(cfm)	Deg F	Deg F	Vent	1,472	1,472	Clg Cfm/Sqft	1.75	SADB	57.5	77.0		
Main Htg	-97.0	5,152	58.3	75.7	Infil	49	49	Clg Cfm/Ton	295.40	Plenum	91.0	59.6	
Aux Htg	0.0	0	0.0	0.0	Supply	5,152	5,152	Clg Sqft/Ton	168.80	Return	78.0	70.0	
Preheat	-0.0	5,152	58.3	56.2	Mincfm	1,803	1,803	Clg Btuh/Sqft	71.09	Ret/OA	81.8	58.3	
Reheat	0.0	0	0.0	0.0	Return	5,152	5,152	No. People	59	Runarnd	78.0	70.0	
Humidif	0.0	0	0.0	0.0	Exhaust	1,472	1,472	Htg % OA	28.6	Fn MtrTD	0.3	0.3	
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	1.75	Fn BldTD	0.2	0.2	
Total	-97.0				Auxil	0	0	Htg Btuh/Sqft	-32.93	Fn Frict	0.7	0.7	

System 6 Peak VTCV - VARIABLE TEMP CONSTANT VOL

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/12 \* Mo/Hr: 7/13 \* Mo/Hr: 13/ 1  
Outside Air ==> OADB/WB/HR: 91/ 76/117.0 \* OADB: 95 \* OADB: 29

	Space	Ret. Air	Ret. Air	Net	Perct		Space	Perct		Space Peak	Coil Peak	Perct
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads												
Skylite Solr	0	0		0	0.00		0	0.00		0	0	0.00
Skylite Cond	0	0		0	0.00		0	0.00		0	0	0.00
Roof Cond	0	3,355		3,355	4.73		0	0.00		0	-2,126	5.67
Glass Solar	3,120	0		3,120	4.39		2,680	6.91		0	0	0.00
Glass Cond	480	0		480	0.68		598	1.54		-1,984	-1,984	5.29
Wall Cond	2,630	226		2,856	4.02		2,709	6.99		-6,457	-8,349	22.27
Partition	0			0	0.00		0	0.00		0	0	0.00
Exposed Floor	0			0	0.00		0	0.00		-3,575	-3,575	9.54
Infiltration	801			801	1.13		315	0.81		-776	-776	2.07
Sub Total==>	7,031	3,581		10,612	14.95		6,302	16.26		-12,793	-16,811	44.85
Internal Loads												
Lights	4,691	828		5,519	7.77		4,691	12.10		0	0	0.00
People	9,723			9,723	13.70		4,557	11.76		0	0	0.00
Misc	1,792	0	0	1,792	2.52		1,433	3.70		0	0	0.00
Sub Total==>	16,206	828	0	17,034	23.99		10,681	27.56		0	0	0.00
Ceiling Load	4,409	-4,409		0	0.00		5,085	13.12		-4,018	0	0.00
Outside Air	0	0	0	24,042	33.87		0	0.00		0	-23,285	62.12
Sup. Fan Heat				2,613	3.68			0.00			2,613	-6.97
Ret. Fan Heat		0		0	0.00			0.00			0	0.00
Duct Heat Pkup		0		0	0.00			0.00			0	0.00
OV/UNDR Sizing	16,692			16,692	23.51		16,692	43.06		0	0	0.00
Exhaust Heat		0	0	0	0.00			0.00			0	0.00
Terminal Bypass		0	0	0	0.00			0.00			0	0.00
Grand Total==>	44,338	0	0	70,994	100.00		38,761	100.00		-16,811	-37,483	100.00

-----COOLING COIL SELECTION-----											-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR				Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	5.9	71.0	48.2	1,837	81.8	68.1	84.2	57.2	55.9	67.0	Part	0	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	109	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Roof	1,050	0 0
Totals	5.9	71.0									Wall	1,526	40 3

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent			Clg Cfm/Sqft			SADB		
Main Htg	-37.5	1,838	58.3	77.1	Infil	18	18	Clg Cfm/Ton	310.59		Plenum	91.3	57.9
Aux Htg	0.0	0	0.0	0.0	Supply	1,837	1,838	Clg Sqft/Ton	177.48		Return	78.0	70.0
Preheat	-0.0	1,837	58.3	57.2	Mincfm	643	643	Clg Btuh/Sqft	67.61		Ret/OA	81.8	58.3
Reheat	0.0	0	0.0	0.0	Return	1,837	1,838	No. People	21		Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	525	525	Htg % OA	28.6		Fn MtrTD	0.3	0.3
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	1.75		Fn BldTD	0.2	0.2
Total	-37.5				Auxil	0	0	Htg Btuh/Sqft	-35.70		Fn Frict	0.7	0.7

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 GL)	GAS DMND On Peak (Thrm/hr)
Jan	99,942	275	333	1	4
Feb	91,512	262	438	1	3
March	130,513	283	84	23	1
April	136,166	335	10	49	0
May	149,138	382	0	72	0
June	153,772	406	0	90	0
July	161,171	427	0	105	0
Aug	168,454	433	0	114	0
Sept	151,379	415	0	86	0
Oct	137,693	306	51	39	1
Nov	121,654	289	114	20	1
Dec	110,713	276	471	3	3
Total	1,612,106	433	1,501	602	4

Building Energy Consumption = 173,625 (Btu/Sq Ft/Year)  
Source Energy Consumption = 511,949 (Btu/Sq Ft/Year)

Floor Area = 32,554 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref Num	Equip Code	----- Monthly Consumption -----												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	20835	19168	22501	20835	21668	21668	20835	22501	20835	21668	19168	20835	252,515
	PK	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1
1	MISC LD													
	ELEC	45403	41009	45403	43938	45403	43938	45403	45403	43938	45403	43938	45403	534,579
	PK	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1100L	AIR-CLD RECIP >45 TONS												
	ELEC	2397	1744	10502	14864	18798	21700	24137	26187	21193	14718	10618	3974	170,832
	PK	37.5	37.5	42.4	69.2	80.8	91.3	98.7	98.4	91.5	63.9	49.5	37.5	98.7
1	EQ5200	CONDENSER FANS												
	ELEC	103	70	612	1208	1655	1988	2559	2448	2003	1104	618	178	14,547
	PK	0.8	0.7	2.5	7.0	8.5	9.3	10.5	10.5	9.4	4.6	3.1	1.4	10.5
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	1864	1655	2677	2498	2580	2580	2498	2677	2498	2580	2274	2081	28,463
	PK	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
1	EQ5303	CONTROLS												
	ELEC	75	67	108	100	104	104	100	108	100	104	91	84	1,145
	PK	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2	EQ1001S	2-STG CTV <555 TONS												
	ELEC	212	443	7155	12986	17986	21714	25147	27652	21182	10645	6201	1116	152,438
	PK	26.4	26.4	32.0	64.5	82.8	97.3	112.6	116.6	106.7	42.7	33.8	26.4	116.6
	EQ5100	COOLING TOWER												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

ELEC	328	0	4543	4584	4735	4735	4584	4912	4584	4735	3859	1970	43,569
PK	13.7	0.0	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
2 EQ5100	COOLING TOWER												
WATER	1	1	23	49	72	90	105	114	86	39	20	3	602
PK	0.0	0.0	0.1	0.3	0.4	0.4	0.5	0.5	0.5	0.2	0.1	0.0	0.5
2 EQ5001	CHILLED WATER PUMP C.V.												
ELEC	366	789	3796	3830	3956	3956	3830	4105	3830	3956	3224	1898	37,538
PK	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
2 EQ5010	CONDENSER WATER PUMP C.V.												
ELEC	477	1029	4951	4996	5160	5160	4996	5354	4996	5160	4206	2476	48,963
PK	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
2 EQ5300	CONTROL PANEL & INTERLOCK												
ELEC	32	69	332	335	346	346	335	359	335	346	282	166	3,283
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	9679	8743	9679	9367	9679	9367	9679	9679	9367	9679	9367	9679	113,968
PK	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
1 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1406	1270	1406	1361	1406	1361	1406	1406	1361	1406	1361	1406	16,556
PK	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
3 EQ4001	AIRFOIL CENTRIF. FAN C.V.												
ELEC	12760	11525	12760	12348	12760	12348	12760	12760	12348	12760	12348	12760	150,234
PK	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
4 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
PK	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
5 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
6 EQ4003	FC CENTRIF. FAN C.V.												
ELEC	744	672	744	720	744	720	744	744	720	744	720	744	8,760
PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	6	8	11	0	0	0	0	0	0	4	12	84	126
PK	0.7	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.7
1 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	410	559	753	37	0	0	0	0	0	261	761	2759	5,541
PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5
EQ5240	BOILER FORCED DRAFT FAN												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

ELEC	16	21	29	1	0	0	0	0	0	10	29	105	212
PK	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3
1 EQ5307	BOILER CONTROLS												
ELEC	28	38	51	3	0	0	0	0	0	18	51	185	372
PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5
2 EQ2001	GAS FIRE TUBE HOT WATER												
GAS	327	430	73	9	0	0	0	0	0	47	102	387	1,375
PK	3.0	3.2	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.6	0.7	2.7	3.2
2 EQ5020	HEAT WATER CIRC. PUMP C.V.												
ELEC	261	278	142	26	0	0	0	0	0	96	180	296	1,280
PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7
2 EQ5240	BOILER FORCED DRAFT FAN												
ELEC	214	228	116	21	0	0	0	0	0	79	148	243	1,051
PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6
2 EQ5307	BOILER CONTROLS												
ELEC	175	186	95	18	0	0	0	0	0	65	121	199	858
PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5

UTILITY PEAK CHECKSUMS - ALTERNATIVE 2

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 432.7 (kW)  
Yearly Time of Peak 12 (hr) 8 (mo)

Hour 12 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
Cooling Equipment				
1	EQ1100L	AIR-CLD RECIP >45 TONS	113.0	26.11
2	EQ1001S	2-STG CTV <555 TONS	157.7	36.44
Sub Total			270.6	62.54
Sub Total			0.0	0.00
Air Moving Equipment				
1	SUMMATION OF FAN ELECTRICAL DEMAND		13.0	3.01
2	SUMMATION OF FAN ELECTRICAL DEMAND		1.9	0.44
3	SUMMATION OF FAN ELECTRICAL DEMAND		17.1	3.96
	SUMMATION OF FAN ELECTRICAL DEMAND		1.4	0.34
	SUMMATION OF FAN ELECTRICAL DEMAND		1.5	0.34
6	SUMMATION OF FAN ELECTRICAL DEMAND		1.0	0.23
Sub Total			36.0	8.31
Sub Total			0.0	0.00
Miscellaneous				
Lights			65.1	15.05
Base Utilities			0.0	0.00
Misc Equipment			61.0	14.10
Sub Total			126.1	29.15
Grand Total			432.7	100.00

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TRACE 600 ANALYSIS  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
EEAP ALTERNATIVES

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 74 (F)  
Winter Design Dry Bulb: 29 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 15:10:27 4/17/94  
Dataset Name: B1395 .TM



AIRFLOW - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	BPMZ	4,577	16,774	16,774	16,926	4,730	0	0
2	VTCV	944	3,302	3,302	3,334	975	0	0
3	BPMZ	7,229	25,835	25,835	26,076	7,470	0	0
4	VTCV	1,530	5,355	5,355	5,406	1,581	0	0
5	VTCV	1,472	5,152	5,152	5,201	1,521	0	0
6	VTCV	525	1,837	1,838	1,855	542	0	0
Totals		16,277	58,255	58,255	58,798	16,820	0	0

CAPACITY - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

Cooling					Heating							
System Number	System Type	Main Sys. Capacity (Tons)	Aux. Sys. Capacity (Tons)	Opt. Vent Capacity (Tons)	Cooling Totals (Tons)	Main Sys. Capacity (Btuh)	Aux. Sys. Capacity (Btuh)	Preheat Capacity (Btuh)	Reheat Capacity (Btuh)	Humidif. Capacity (Btuh)	Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	BPMZ	61.4	0.0	0.0	61.4	-234,413	0	0	0	0	0	-234,413
2	VTCV	11.2	0.0	0.0	11.2	-50,285	0	0	0	0	0	-50,285
3	BPMZ	78.9	0.0	0.0	78.9	-408,239	0	0	0	0	0	-408,239
4	VTCV	17.8	0.0	0.0	17.8	-69,699	0	0	0	0	0	-69,699
5	VTCV	17.4	0.0	0.0	17.4	-96,956	0	0	0	0	0	-96,956
6	VTCV	5.9	0.0	0.0	5.9	-37,483	0	0	0	0	0	-37,483
Totals		192.6	0.0	0.0	192.6	-897,074	0	0	0	0	0	-897,074

The building peaked at hour 13 month 8 with a capacity of 192.6 tons

ENGINEERING CHECKS - ALTERNATIVE 3  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	----- Cooling -----				--- Heating ---		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	BPMZ	27.29	1.83	273.4	149.2	80.42	1.83	-25.60	9,155
2	Main	VTCV	28.57	1.75	294.7	168.4	71.26	1.75	-26.65	1,887
3	Main	BPMZ	27.98	1.79	327.6	183.3	65.45	1.79	-28.24	14,458
4	Main	VTCV	28.57	1.75	301.3	172.2	69.70	1.75	-22.78	3,060
5	Main	VTCV	28.57	1.75	295.4	168.8	71.09	1.75	-32.93	2,944
6	Main	VTCV	28.57	1.75	310.6	177.5	67.61	1.75	-35.70	1,050

System 1 Block BPMZ - BYPASS MULTIZONE

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 8/14 \* Mo/Hr: 13/ 1  
Outside Air ==> OADB/WB/HR: 95/ 76/111.1 \* OADB: 95 \* OADB: 29

	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)		Space Sensible (Btuh)	Perct Of Tot (%)		Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Envelope Loads												
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	40,114		40,114	5.45	*	0	0.00	*	0	-21,001	8.96
Glass Solar	12,236	0		12,236	1.66	*	32,186	7.11	*	0	0	0.00
Glass Cond	4,272	0		4,272	0.58	*	-2,136	-0.47	*	-13,196	-13,196	5.63
Wall Cond	3,452	-1,645		1,807	0.25	*	3,833	0.85	*	-8,979	-11,850	5.06
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	-5,412	-5,412	2.31
Infiltration	6,974			6,974	0.95	*	2,279	0.50	*	-6,767	-6,767	2.89
Sub Total==>	26,933	38,470		65,403	8.88	*	36,163	7.99	*	-34,355	-58,227	24.84
Internal Loads												
Lights	41,432	7,312		48,744	6.62	*	42,270	9.34	*	0	0	0.00
People	70,503			70,503	9.58	*	47,163	10.42	*	0	0	0.00
Misc	90,670	0	0	90,670	12.31	*	72,536	16.03	*	0	0	0.00
Sub Total==>	202,605	7,312	0	209,917	28.51	*	161,969	35.78	*	0	0	0.00
Ceiling Load	37,295	-37,295		0	0.00	*	36,089	7.97	*	-23,872	0	0.00
Outside Air	0	0	0	209,207	28.41	*	0	0.00	*	0	-203,024	86.61
Sup. Fan Heat				26,838	3.65	*		0.00	*		26,838	-11.45
Ret. Fan Heat		8,946		8,946	1.22	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	218,400			218,400	29.66	*	218,400	48.25	*	0	0	0.00
Exhaust Heat		-2,441	0	-2,441	-0.33	*		0.00	*		0	0.00
Terminal Bypass		0	0	0	-0.00	*		0.00	*		0	0.00
Grand Total==>	485,234	14,991	0	736,270	100.00	*	452,621	100.00	*	-58,227	-234,413	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
				Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	61.4	736.3	555.8	16,774	83.5	68.2	82.4	51.9	51.0	55.7	9,155	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	165	
Totals	61.4	736.3									9,155	
											2,310	266 12

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
					Vent	4,577	4,577	Clg Cfm/Sqft	27.3		SADB	53.1	73.2
Main Htg	-234.4	16,774	60.3	73.2	Infil	153	153	Clg Cfm/Ton	1.83		Plenum	90.9	61.8
Aux Htg	0.0	0	0.0	0.0	Supply	16,774	16,774	Clg Sqft/Ton	273.38		Return	78.5	70.0
Preheat	-0.0	16,774	60.3	53.1	Mincfm	0	0	Clg Btuh/Sqft	80.42		Ret/OA	83.1	58.8
Reheat	0.0	0	0.0	0.0	Return	16,774	16,774	No. People	183		Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	4,577	4,577	Htg % OA	27.3		Fn MtrTD	0.5	0.5
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/SqFt	1.83		Fn BldTD	0.4	0.4
Total	-234.4				Auxil	0	0	Htg Btuh/SqFt	-25.60		Fn Frict	1.1	1.1

System 2 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 92			OADB: 29		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	6,075		6,075	4.52	0	0.00	0	-4,137	8.23
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	2,086	153		2,238	1.66	2,759	3.77	-5,412	-7,065	14.05
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-2,886	-2,886	5.74
Infiltration	1,475			1,475	1.10	493	0.67	-1,395	-1,395	2.77
Sub Total==>	3,560	6,228		9,789	7.28	3,252	4.44	-9,693	-15,483	30.79
Internal Loads										
Lights	8,430	1,488		9,918	7.38	8,759	11.96	0	0	0.00
People	17,351			17,351	12.90	9,907	13.53	0	0	0.00
Misc	12,881	0	0	12,881	9.58	10,305	14.07	0	0	0.00
Sub Total==>	38,662	1,488	0	40,150	29.86	28,970	39.56	0	0	0.00
Ceiling Load	7,716	-7,716		0	0.00	7,764	10.60	-5,790	0	0.00
Outside Air	0	0	0	44,242	32.90	0	0.00	0	-41,847	83.22
Sup. Fan Heat				7,045	5.24		0.00		7,045	-14.01
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat PkUp		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	33,246			33,246	24.72	33,246	45.40	0	0	0.00
Reheat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	83,184	0	0	134,471	100.00	73,232	100.00	-15,483	-50,285	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity (Tons)		Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	11.2	134.5	90.7	3,302	Deg F	Deg F	Grains	Deg F	Deg F	Floor	1,887	
Aux Clg	0.0	0.0	0.0	0	81.8	67.9	83.1	55.5	54.8	Part	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	ExFlr	88	
Totals	11.2	134.5			0.0	0.0	0.0	0.0	0.0	Roof	1,887	0 0
										Wall	1,232	0 0

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			-----ENGINEERING CHECKS-----		-----TEMPERATURES (F)-----		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
Main Htg	-50.3	3,302	58.3	Vent	944	944	28.6			SADB	57.5	74.3
Aux Htg	0.0	0	0.0	Infil	31	31	1.75			Plenum	90.9	60.3
Preheat	-0.0	3,302	58.3	Supply	3,302	3,302	294.69			Return	78.0	70.0
Reheat	0.0	0	0.0	Mincfm	0	0	168.39			Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	Return	3,302	3,302	71.26			Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	Exhaust	944	944	38			Fn MtrTD	0.5	0.5
Total	-50.3			Rm Exh	0	0	28.6			Fn BldTD	0.4	0.4
				Auxil	0	0	1.75			Fn Frict	1.1	1.1
							Htg Btuh/SqFt	-26.65				

System 3 Block BPMZ - BYPASS MULTIZONE

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==>					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==>					OADB: 92			OADB: 29		
Space	Ret. Air	Ret. Air	Net	Perct	Space	Perct	Space Peak	Coil Peak	Perct	
Sens.+Lat.	Sensible	Latent	Total	Of Tot	Sensible	Of Tot	Space Sens	Tot Sens	Of Tot	
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)	
Envelope Loads										
Skylite Solr	0	0	0	0.00	0	0.00	0	0	0.00	
Skylite Cond	0	0	0	0.00	0	0.00	0	0	0.00	
Roof Cond	0	62,339	62,339	6.59	0	0.00	0	-33,704	8.26	
Glass Solar	42,112	0	42,112	4.45	52,528	9.89	0	0	0.00	
Glass Cond	23,383	0	23,383	2.47	21,917	4.13	-72,232	-72,232	17.69	
Wall Cond	1,603	-12	1,591	0.17	1,697	0.32	-4,797	-6,356	1.56	
Partition	0	0	0	0.00	0	0.00	0	0	0.00	
Exposed Floor	0	0	0	0.00	0	0.00	-5,970	-5,970	1.46	
Infiltration	10,128	0	10,128	1.07	3,858	0.73	-10,688	-10,688	2.62	
Sub Total==>	77,226	62,327	139,553	14.75	80,000	15.07	-93,686	-128,949	31.59	
Internal Loads										
Lights	65,432	11,547	76,978	8.13	67,039	12.62	0	0	0.00	
People	111,037	0	111,037	11.73	73,321	13.81	0	0	0.00	
Misc	61,953	0	61,953	6.55	49,562	9.33	0	0	0.00	
Sub Total==>	238,422	11,547	249,969	26.41	189,922	35.77	0	0	0.00	
Ceiling Load	63,922	-63,922	0	0.00	59,367	11.18	-35,263	0	0.00	
Outside Air	0	0	303,836	32.11	0	0.00	0	-320,625	78.54	
Sup. Fan Heat			41,336	4.37		0.00		41,336	-10.13	
Ret. Fan Heat		13,779	13,779	1.46		0.00		0	0.00	
Duct Heat Pkup		0	0	0.00		0.00		0	0.00	
OV/UNDR Sizing	201,715		201,715	21.32	201,715	37.99	0	0	0.00	
Exhaust Heat		-3,855	-3,855	-0.41		0.00		0	0.00	
Minimal Bypass		0	0	-0.00		0.00		0	0.00	
Grand Total==>	581,285	19,875	946,332	100.00	531,003	100.00	-128,949	-408,239	100.00	

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Floor			
Main Clg	78.9	946.3	25,835	83.6	69.0	86.6	57.9	57.3	Part	0		
Aux Clg	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	ExFlr	182		
Opt Vent	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	Roof	14,458	0	0
Totals	78.9	946.3							Wall	2,548	1,456	57

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)--		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F	Vent			Clg Cfm/Sqft			SADB		
Main Htg	-408.2	25,835	60.0	74.6	7,229	7,229	1.79			Plenum	92.0	62.3
Aux Htg	0.0	0	0.0	0.0	241	241	327.60			Return	78.5	70.0
Preheat	-0.0	25,835	60.0	59.0	25,835	25,835	183.34			Ret/OA	83.3	58.5
Reheat	0.0	0	0.0	0.0	9,042	9,042	65.45			Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	25,835	25,835	289			Fn MtrTD	0.5	0.5
Opt Vent	0.0	0	0.0	0.0	7,229	7,229	28.0			Fn BldTD	0.4	0.4
Total	-408.2				0	0	1.79			Fn Frict	1.1	1.1
				Auxil	0	0	Htg Btuh/SqFt	-28.24				

System 4 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****		
Peak at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 92			OADB: 29		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	9,873		9,873	4.63	0	0.00	0	-7,193	10.32
Glass Solar	0	0		0	0.00	0	0.00	0	0	0.00
Glass Cond	0	0		0	0.00	0	0.00	0	0	0.00
Wall Cond	0	0		0	0.00	0	0.00	0	0	0.00
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	2,343			2,343	1.10	799	0.67	-2,262	-2,262	3.25
Sub Total==>	2,343	9,873		12,216	5.73	799	0.67	-2,262	-9,455	13.57
Internal Loads										
Lights	13,316	2,350		15,666	7.35	14,381	12.11	0	0	0.00
People	28,121			28,121	13.19	16,065	13.53	0	0	0.00
Misc	20,888	0	0	20,888	9.79	16,710	14.07	0	0	0.00
Sub Total==>	62,325	2,350	0	64,675	30.33	47,156	39.71	0	0	0.00
Ceiling Load	12,223	-12,223		0	0.00	12,324	10.38	-7,193	0	0.00
Outside Air	0	0	0	70,287	32.96	0	0.00	0	-67,860	97.36
Sup. Fan Heat				7,616	3.57		0.00		7,616	-10.93
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat PkUp		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	58,475			58,475	27.42	58,475	49.24	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Minimal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	135,365	0	0	213,268	100.00	118,754	100.00	-9,455	-69,699	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
Main Clg	17.8	213.3	143.6	5,355	81.8	68.0	56.2	55.5	66.7	Floor	3,060	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	Part	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	ExFlr	0	
Totals	17.8	213.3								Roof	3,060	0 0
										Wall	0	0 0

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)--		
	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA		Type	Clg	Htg
Main Htg	-69.7	5,355	58.3	70.3	Vent	1,530	1,530	28.6		SADB	57.5	71.6
Aux Htg	0.0	0	0.0	0.0	Infil	51	51	1.75		Plenum	90.6	62.6
Preheat	-0.0	5,355	58.3	56.2	Supply	5,355	5,355	301.31		Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Mincfm	1,874	1,874	172.18		Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	Return	5,355	5,355	69.70		Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Exhaust	1,530	1,530	61		Fn MtrTD	0.3	0.3
Total	-69.7				Rm Exh	0	0	28.6		Fn BldTD	0.2	0.2
					Auxil	0	0	1.75		Fn Frict	0.7	0.7
								Htg Btuh/SqFt	-22.78			

System 5 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****					CLG SPACE PEAK *****					HEATING COIL PEAK *****				
Peaked at Time ==> Mo/Hr: 8/12					Mo/Hr: 7/13					Mo/Hr: 13/ 1				
Outside Air ==> OADB/WB/HR: 91/ 76/117.0					OADB: 95					OADB: 29				
Space	Ret. Air	Ret. Air	Net	Perct	Space	Perct	Space	Coil Peak	Perct	Space	Coil Peak	Perct	Space	Coil Peak
Sens.+Lat.	Sensible	Latent	Total	Of Tot	Sensible	Of Tot	Space Sens	Tot Sens	Of Tot	Space Sens	Tot Sens	Of Tot	Space	Coil Peak
(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)	(Btuh)	(Btuh)	(%)	(Btuh)	(Btuh)
Envelope Loads														
Skylite Solr	0	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0
Skylite Cond	0	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0
Roof Cond	0	9,457	9,457	4.52	0	0.00	0	-6,315	6.51	0	-6,315	6.51	0	0
Glass Solar	17,940	0	17,940	8.57	15,410	13.49	0	0	0.00	0	0	0.00	0	0
Glass Cond	2,758	0	2,758	1.32	3,441	3.01	-11,410	-11,410	11.77	-11,410	-11,410	11.77	-11,410	-11,410
Wall Cond	3,888	359	4,247	2.03	4,317	3.78	-9,779	-13,125	13.54	-9,779	-13,125	13.54	-9,779	-13,125
Partition	0	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0
Exposed Floor	0	0	0	0.00	0	0.00	-5,970	-5,970	6.16	-5,970	-5,970	6.16	-5,970	-5,970
Infiltration	2,283	0	2,283	1.09	883	0.77	-2,176	-2,176	2.24	-2,176	-2,176	2.24	-2,176	-2,176
Sub Total==>	26,868	9,816	36,684	17.53	24,051	21.05	-29,335	-38,996	40.22	-29,335	-38,996	40.22	-29,335	-38,996
Internal Loads														
Lights	13,153	2,321	15,474	7.39	13,153	11.51	0	0	0.00	0	0	0.00	0	0
People	27,261	0	27,261	13.03	12,777	11.18	0	0	0.00	0	0	0.00	0	0
Misc	20,096	0	20,096	9.60	16,077	14.07	0	0	0.00	0	0	0.00	0	0
Sub Total==>	60,510	2,321	62,831	30.02	42,006	36.77	0	0	0.00	0	0	0.00	0	0
Ceiling Load	12,137	-12,137	0	0.00	14,225	12.45	-9,661	0	0.00	-9,661	0	0.00	-9,661	0
Outside Air	0	0	68,479	32.72	0	0.00	0	-65,287	67.34	0	-65,287	67.34	0	-65,287
Sup. Fan Heat			7,327	3.50		0.00		7,327	-7.56		7,327	-7.56		7,327
Ret. Fan Heat		0	0	0.00		0.00		0	0.00		0	0.00		0
Duct Heat Pkup		0	0	0.00		0.00		0	0.00		0	0.00		0
OV/UNDR Sizing	33,971		33,971	16.23	33,971	29.73	0	0	0.00	0	0	0.00	0	0
Exhaust Heat		0	0	0.00		0.00		0	0.00		0	0.00		0
Terminal Bypass		0	0	0.00		0.00		0	0.00		0	0.00		0
Grand Total==>	133,486	0	209,292	100.00	114,252	100.00	-38,996	-96,956	100.00	-38,996	-96,956	100.00	-38,996	-96,956

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Floor			
Main Clg	17.4	209.3	141.3	5,152	81.8	67.9	83.5	56.2	55.0	2,944		
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0		
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	182		
Totals	17.4	209.3								2,944	0	0
										2,548	230	9

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA				Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F										
Main Htg	-97.0	5,152	58.3	75.7	1,472	1,472	28.6	1.75	295.40	59.6	SADB	57.5	77.0
Aux Htg	0.0	0	0.0	0.0	49	49	Clg Cfm/Sqft		168.80	70.0	Plenum	91.0	59.6
Preheat	-0.0	5,152	58.3	56.2	1,803	1,803	Clg Sqft/Ton		71.09	58.3	Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	5,152	5,152	Clg Btuh/Sqft		59	70.0	Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	1,472	1,472	No. People		28.6	0.3	Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	0	0	Htg % OA		1.75	0.2	Fn MtrTD	0.3	0.3
Total	-97.0				0	0	Htg Cfm/SqFt		-32.93	0.2	Fn BldTD	0.2	0.2
							Htg Btuh/SqFt			0.7	Fn Frict	0.7	0.7

System 6 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****		HEATING COIL PEAK *****		
Peaked at Time ==> Mo/Hr: 8/12						Mo/Hr: 7/13		Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 91/ 76/117.0						OADB: 95		OADB: 29		
Envelope Loads	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Perct Of Tot (%)	Space Sensible (Btuh)	Perct Of Tot (%)	Space Peak (Btuh)	Coil Peak (Btuh)	Perct Of Tot (%)
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	3,355		3,355	4.73	0	0.00	0	-2,126	5.67
Glass Solar	3,120	0		3,120	4.39	2,680	6.91	0	0	0.00
Glass Cond	480	0		480	0.68	598	1.54	-1,984	-1,984	5.29
Wall Cond	2,630	226		2,856	4.02	2,709	6.99	-6,457	-8,349	22.27
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	-3,575	-3,575	9.54
Infiltration	801			801	1.13	315	0.81	-776	-776	2.07
Sub Total==>	7,031	3,581		10,612	14.95	6,302	16.26	-12,793	-16,811	44.85
*****										
Internal Loads										
Lights	4,691	828		5,519	7.77	4,691	12.10	0	0	0.00
People	9,723			9,723	13.70	4,557	11.76	0	0	0.00
Misc	1,792	0	0	1,792	2.52	1,433	3.70	0	0	0.00
Sub Total==>	16,206	828	0	17,034	23.99	10,681	27.56	0	0	0.00
Ceiling Load	4,409	-4,409		0	0.00	5,085	13.12	-4,018	0	0.00
Outside Air	0	0	0	24,042	33.87	0	0.00	0	-23,285	62.12
Sup. Fan Heat				2,613	3.68		0.00		2,613	-6.97
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	16,692			16,692	23.51	16,692	43.06	0	0	0.00
Must Heat		0	0	0	0.00		0.00		0	0.00
Minimal Bypass		0	0	0	0.00		0.00		0	0.00
*****										
Grand Total==>	44,338	0	0	70,994	100.00	38,761	100.00	-16,811	-37,483	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity		Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	5.9	71.0	48.2	1,837	81.8	68.1	84.2	57.2	55.9	67.0	1,050	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	109	
Totals	5.9	71.0									1,050	
											0	0
											1,526	40 3

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
(Mbh)	(cfm)	Deg F	Deg F	Vent								
Main Htg	-37.5	1,838	58.3	77.1	Infil	18		28.6		SADB	58.5	78.5
Aux Htg	0.0	0	0.0	0.0	Supply	1,837	1,838	1.75		Plenum	91.3	57.9
Preheat	-0.0	1,837	58.3	57.2	Mincfm	643	643	310.59		Return	78.0	70.0
Reheat	0.0	0	0.0	0.0	Return	1,837	1,838	177.48		Ret/OA	81.8	58.3
Humidif	0.0	0	0.0	0.0	Exhaust	525	525	67.61		Runarnd	78.0	70.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	21		Fn MtrTD	0.3	0.3
Total	-37.5				Auxil	0	0	28.6		Fn BldTD	0.2	0.2
								1.75		Fn Frict	0.7	0.7
								-35.70				



MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 3

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC On Peak (kWh)	DEMAND On Peak (kW)	GAS On Peak (Therm)	WATER (1000 Gl)	GAS DMND On Peak (Thrm/hr)
Jan	106,965	245	334	6	4
Feb	95,826	226	434	5	3
March	125,903	252	79	42	1
April	123,784	279	10	79	0
May	132,214	308	0	112	0
June	133,504	321	0	137	0
July	137,741	332	0	158	0
Aug	143,418	337	0	173	0
Sept	131,994	329	0	135	0
Oct	126,957	263	51	68	1
Nov	116,934	255	115	40	1
Dec	113,849	245	474	12	3
Total	1,489,086	337	1,498	965	4

Building Energy Consumption = 160,719 (Btu/Sq Ft/Year)  
Source Energy Consumption = 473,244 (Btu/Sq Ft/Year)

Floor Area = 32,554 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

----- EQUIPMENT ENERGY CONSUMPTION -----															
Ref Num	Equip Code	----- Monthly Consumption -----												Total	
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec		
0	LIGHTS														
	ELEC	20835	19168	22501	20835	21668	21668	20835	22501	20835	21668	19168	20835	252,515	
	PK	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	
1	MISC LD														
	ELEC	45403	41009	45403	43938	45403	43938	45403	45403	43938	45403	43938	45403	534,579	
	PK	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	
2	MISC LD														
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	MISC LD														
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	MISC LD														
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	MISC LD														
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
6	MISC LD														
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0	
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1	EQ1001S		2-STG CTV <555 TONS												
	ELEC	1380	1183	8631	13100	17985	21603	24995	27589	21576	11622	8013	2816	160,492	
	PK	23.5	23.5	30.7	68.8	86.8	99.8	111.4	115.7	107.7	42.0	33.7	23.5	115.7	
1	EQ5100		COOLING TOWER												
	ELEC	1658	0	6541	6104	6304	6304	6104	6541	6104	6304	5557	4100	61,620	
	PK	18.2	0.0	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	
1	EQ5100		COOLING TOWER												
	WATER	6	5	42	79	112	137	158	173	135	68	40	12	965	
	PK	0.0	0.0	0.2	0.5	0.6	0.7	0.7	0.7	0.7	0.3	0.2	0.1	0.7	
1	EQ5001		CHILLED WATER PUMP C.V.												
	ELEC	4847	4449	8924	8327	8600	8600	8327	8924	8327	8600	7581	6388	91,895	
	PK	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	24.9	
1	EQ5010		CONDENSER WATER PUMP C.V.												
	ELEC	2908	2670	5354	4996	5160	5160	4996	5354	4996	5160	4549	3833	55,137	
	PK	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	
	EQ5300		CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

	ELEC	195	179	359	335	346	346	335	359	335	346	305	257	3,697
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	9679	8743	9679	9367	9679	9367	9679	9679	9367	9679	9367	9679	113,968
	PK	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	1406	1270	1406	1361	1406	1361	1406	1406	1361	1406	1361	1406	16,556
	PK	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
3	EQ4001	AIRFOIL CENTRIF. FAN C.V.												
	ELEC	12760	11525	12760	12348	12760	12348	12760	12760	12348	12760	12348	12760	150,234
	PK	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
4	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
	PK	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
5	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	1079	974	1079	1044	1079	1044	1079	1079	1044	1079	1044	1079	12,702
	PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	744	672	744	720	744	720	744	744	720	744	720	744	8,760
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ2001	GAS FIRE TUBE HOT WATER												
	GAS	334	434	79	10	0	0	0	0	0	51	115	474	1,498
	PK	3.5	3.3	0.9	0.4	0.0	0.0	0.0	0.0	0.0	0.7	0.9	3.1	3.5
1	EQ5020	HEAT WATER CIRC. PUMP C.V.												
	ELEC	2520	2535	1215	224	0	0	0	0	0	932	1633	2923	11,983
	PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5	7.5
1	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	303	305	146	27	0	0	0	0	0	112	196	352	1,442
	PK	0.9	0.9	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9
1	EQ5307	BOILER CONTROLS												
	ELEC	169	170	81	15	0	0	0	0	0	63	109	196	804
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5
2	EQ2001	GAS FIRE TUBE HOT WATER												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5020	HEAT WATER CIRC. PUMP C.V.												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	EQ5240	BOILER FORCED DRAFT FAN												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3

ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PK	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 EQS307 BOILER CONTROLS													
ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PK	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 3

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value        336.7    (kW)  
Yearly Time of Peak   12 (hr)    8 (mo)

Hour 12    Month    8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
----------------------	------------------------	-----------------------	---------------------------	------------------------

Cooling Equipment

1	EQ1001S	2-STG CTV <555 TONS	174.7	51.87
Sub Total			174.7	51.87
Sub Total			0.0	0.00

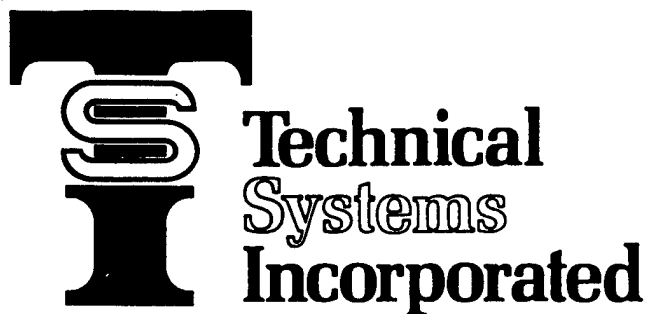
Air Moving Equipment

1	SUMMATION OF FAN ELECTRICAL DEMAND		13.0	3.86
2	SUMMATION OF FAN ELECTRICAL DEMAND		1.9	0.56
3	SUMMATION OF FAN ELECTRICAL DEMAND		17.1	5.09
4	SUMMATION OF FAN ELECTRICAL DEMAND		1.4	0.43
5	SUMMATION OF FAN ELECTRICAL DEMAND		1.5	0.43
6	SUMMATION OF FAN ELECTRICAL DEMAND		1.0	0.30
Sub Total			36.0	10.68
Sub Total			0.0	0.00

Miscellaneous

Lights	65.1	19.33
Base Utilities	0.0	0.00
Misc Equipment	61.0	18.12
Sub Total	126.1	37.46
Grand Total	336.7	100.00

[illegible]



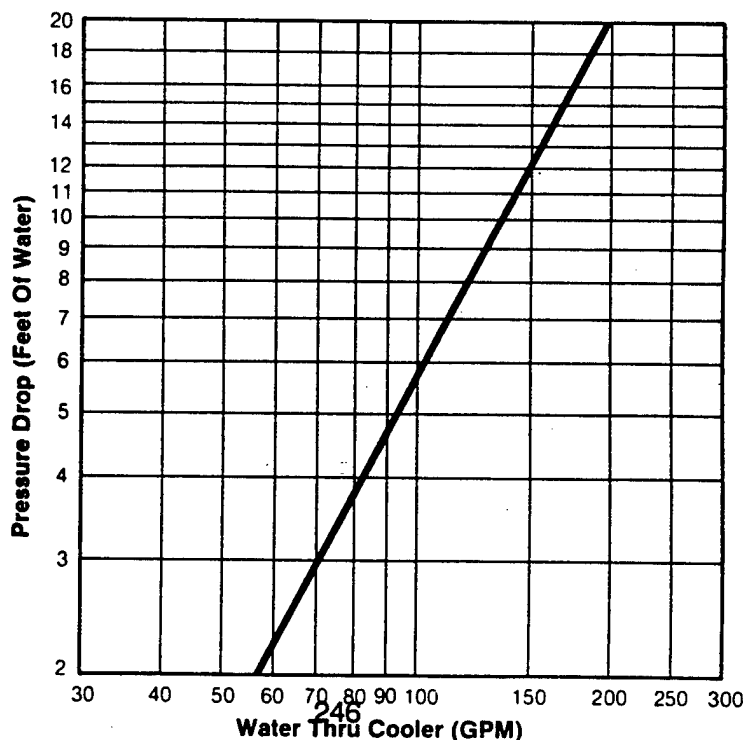
# CA-SC-SE Series Air Cooled Water Chillers CD 80

Air Cooled Water Chillers manufactured by TSI are designed to offer a complete family of units to fulfill the requirements of air conditioning through light industrial duty in sizes ranging from 3 to 135 tons. All units utilize a unique continuous tube condenser surface design which offers maximum heat transfer and minimum pressure drop. Fins are spiral wound under tension for complete metal to metal contact throughout the entire tube surface. Propellor fans are used for high reliability and minimum maintenance. These fans are aluminum bladed, selected for minimum noise and are direct driven by poly-phase motors. Compressors are both full hermetic and accessible hermetic, selected and matched to condensers and evaporators for optimum performance. Direct expansion, removable head coolers are used on CS, CD and CM Model Chillers.

## Performance

Leaving Water Temperature Degrees F	Total Unit Capacity and KW for Compressor							
	AMBIENT TEMPERATURE DEGREES F							
	85		95		105		115	
	Tons	KW	Tons	KW	Tons	KW	Tons	KW
42	64.6	69.2	60.9	72.4	57.4	75.6	53.3	79.0
44	66.9	70.4	63.0	73.8	59.4	77.1	55.3	80.6
45	68.0	71.0	64.1	74.5	60.5	77.7	56.3	81.4
46	69.1	71.5	65.2	75.0	61.5	78.4	57.3	82.2
48	71.4	72.6	67.3	76.4	63.5	80.0	59.2	83.8
50	73.4	73.9	69.3	77.6	65.5	81.6	—	—

## Cooler Pressure Drop - CD 80 Chiller



## Construction Features

**Cabinet** is constructed entirely of mill galvanized sheet steel panels and formed structural members. All panels or louvers are removable for access and service.

**Motors** are three phase, 1140 RPM, specifically designed for vertical shaft, direct drive fan application and utilize permanently lubricated ball bearings. Corrosion resistant steel rod mounting brackets reduce air turbulence and eliminate vibration.

**Fans** are direct propellor type with steel hubs and aluminum blades. Vertical air discharge through a formed venturi minimizes noise generation and air recirculation.

**Condenser coils** are constructed with ½ inch O.D. seamless copper (drawn) tubing and formed to minimize return bends and brazed joints. Fins are spiral wound (aluminum) under tension and designed to be self spacing to completely eliminate exposed copper tubing in the finned area. Coil circuiting has been engineered to incorporate integral sub cooling.

**Compressors** for the "C" Models are accessible hermetic, direct drive by 4 pole motor, complete with overload protection, automatic reversing, oil pump, oil strainer, oil sight glass, suction and discharge service valves. All Compressors are mounted on shock mounts, and all have crankcase heaters.

**Coolers** for the "C" models are direct expansion thru tube design having removable heads. Tubes are seamless copper with aluminum inserts and roller expanded into steel tube sheets. Insulated with closed cell plastic foam insulation.

## Specifications

### CD 80 CHILLER

Copelametic-1750 RPM-Accessible Hermetic Compressor with Internal 3 Leg Protection

Dual Compressors with 2½" ODS Suction Connections

6 Cylinders 2-15/16" Bore X 2-3/16" Stroke Each

Dual Refrigerant Circuits.

6" X 36" Receivers with 1½" ODS Outlet Connections

241 lbs R-22 Refrigerant Operating Charge Above 55° F.

100-67-50-33-0% Capacity Modulation Standard

6-28" Diameter Fans.

### ELECTRICAL DATA — Amperage For Each Compressor

Across The Line Start	208/230/3/60	460/3/60	Part Wind Start	208/230/3/60	460/3/60
Rated Load Amps.	142.0 Each	71.0 Each	Rated Load Amps.	142.0 Each	71.0 Each
Locked Rotor Amps.	594.0 Each	297.0 Each	Locked Rotor Amps.	340.0 Each	225.0 Each

### 1140 RPM FAN MOTORS - FLA and KW

24" Fans Have ½ HP

28" Fans Have 1 HP

All Fan Motors Have Inherent Thermal Protection - 3 Leg Line Break

Voltage	½ HP FLA	½ HP KW	1 HP FLA	1 HP KW
208/3/60	2.4 AMPS	.55 KW	4.8 AMPS	1.1 KW
230/3/60	2.2 AMPS	.55 KW	4.6 AMPS	1.1 KW
460/3/60	1.1 AMPS	.55 KW	2.3 AMPS	1.1 KW

## Standard Features

Direct Drive Condenser Fans  
With Guards  
Liquid Receiver With  
Fusible Plug  
Liquid Line Shut Off Valve  
Liquid Line Drier  
(Replaceable Core)  
Liquid Line Sight Glass/  
Moisture Indicator  
Thermostatic Expansion Valve

Refrigerant Charging Valve  
High Pressure Safety Control  
Low Pressure Operating Control  
Oil Failure Control  
Compressor Service Valves  
Auto-Pumpdown Switch  
Integral Subcooling  
Crankcase Heater  
Vibration Isolation Under  
Compressor

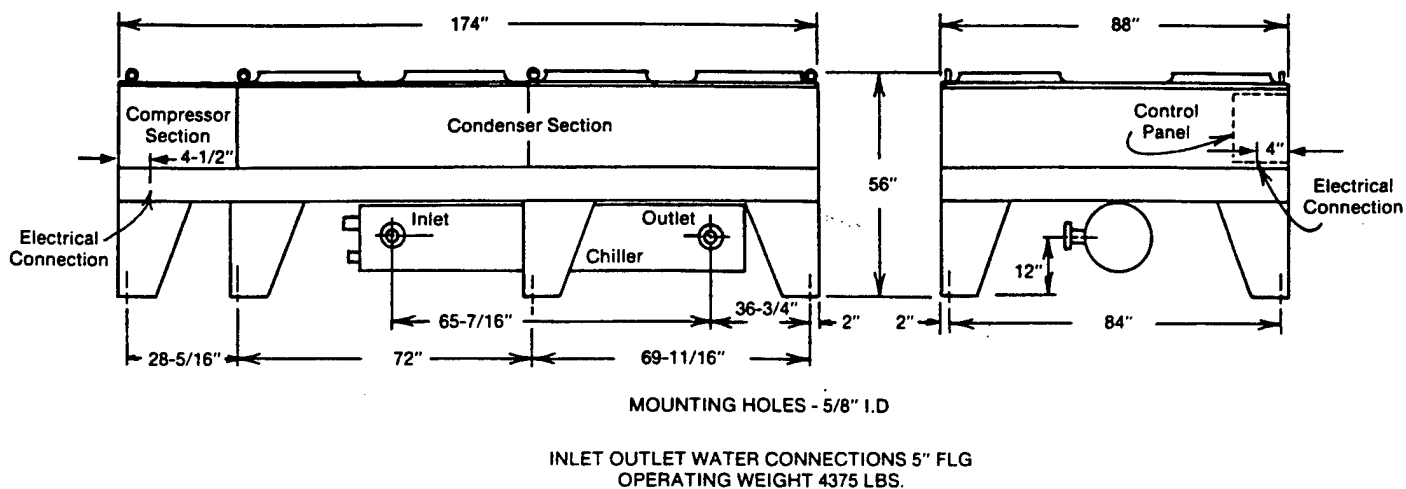
Removable Access Panels  
Hinged Control Panel Access  
Rigging Points  
Low Profile  
Compressor Overload Protection  
Fan Motor Overload Protection  
Fused Control Circuit 115V  
Compressor Contactor  
Fan Motor Contactor  
Prewired Controls

Freeze Control  
Return Water Temperature Control  
Insulated Evaporator  
Insulated Suction Lines  
Refrigerant Charge (CA Only)  
Time Delay Between Compressors  
F20 Fan Control  
Chiller Heater  
Manual Lead Lag Control  
Flow Switch (Loose)

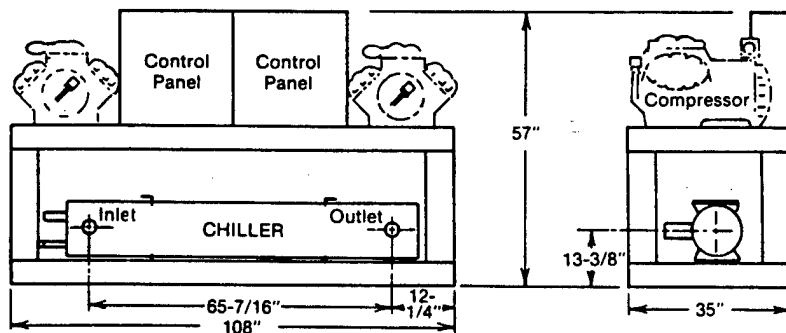
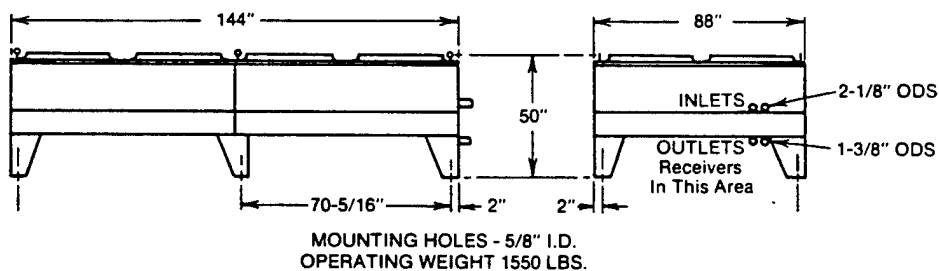


# Dimensions

## CA 2 CD 80

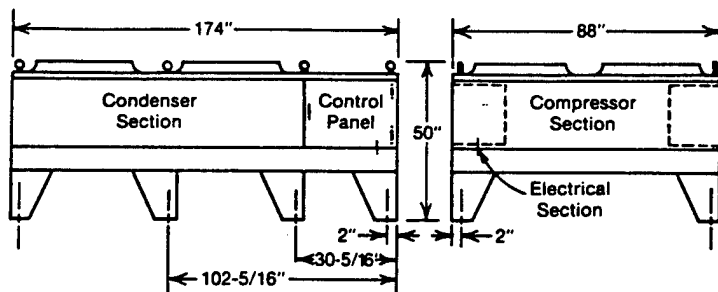


## SC 2 CD 80

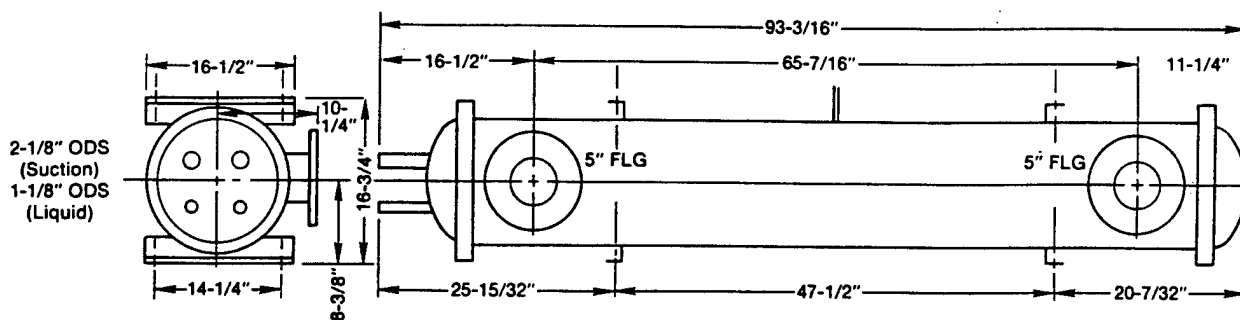


248  
INLET OUTLET WATER CONNECTIONS 5" FLG  
OPERATING WEIGHT 2920 LBS.

# SE 2 CD 80

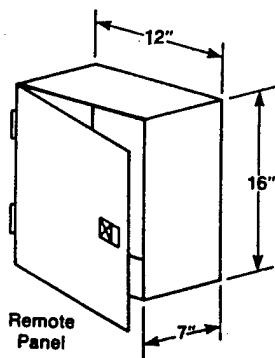


MOUNTING HOLES - 5/8" I.D.  
OPERATING WEIGHT 3100 LBS.



MOUNTING HOLES 5/8" I.D.

OPERATING WEIGHT 1357 LBS.



Remote Panel  
SE Model Only . . .  
Contains system run/  
pumpdown switch,  
return water thermostat  
and control interlocks.

NOTE: Liquid line kit shipped loose (solenoid, sight glass, drier, TXV).

Continual engineering and research for product improvement may result in design and specification changes. Consult factory for certified drawings.

## Technical Systems Incorporated

### Air Conditioning

249

Post Office Box 309  
Pryor, Oklahoma 74361

CarrierBuilding Systems & Services  
Division of Carrier Corporation4084 Sandshell Drive  
Fort Worth, TX 76137  
(817) 232-2229TOTAL NUMBER OF PAGES TO FOLLOW: 7 (INCLUDING COVER SHEET)

PLEASE CHECK ONE OF THE FOLLOWING:

☒ NO CONFIRMATION REQUIRED☐ CONFIRMATION NECESSARY

PHONE: (817) 847-0082

TO:

SCOTT CLARK

COMMENTS:

FT Sam Harris - 23XL CHILLER

FROM:

COB

DEPARTMENT:

DATE:

TIME:

WE ARE TRANSMITTING FROM FAX NUMBER (817) 847-8135

**Carrier Corporation**

4084 Sandshell Drive  
Fort Worth, TX 76137  
(817) 232-2228  
FAX: (817) 847-8135

SEPTEMBER 16, 1993

CARTER AND BURGESS  
FORT WORTH, TEXAS

ATTN: SCOTT CLARK

SUBJECT: FT. SAM HOUSTON  
154 TON CHILLER REPLACEMENT

DEAR MR. CLARK,

PLEASE FIND ATTACHED SELECTION RUNS FOR BOTH 154 TONS AND 234 TON  
RESPECTIVELY. AS REQUESTED THE FOLLOWING IS BUDGETARY PRICING WITH  
THE EQUIPMENT DESCRIPTION. PLEASE NOTE:

ITEM 1- REFRIGERATION MACHINE - ROTARY SCREW TYPE - 23XL SERIES  
QUANTITY-001, MARK FOR 154 TON

Carrier 23 series hermetic screw chiller each  
complete with compressor, motor, cooler, condenser,  
and control console ready for electrical connections.  
Microprocessor controls include manual/auto  
start, safety indicator and alarm, soft loading, under  
voltage protection, motor current indication, low load  
recycle, slide valve control, self-diagnostic check,  
start-counter, and running time indicator. This machine  
is tested and completely assembled at the factory.  
The standard control wiring is factory installed  
and wired to terminal strip for connection to starter and  
pipe mounted flow switches.

In addition, the following items are included:

- Initial charge of R-22 refrigerant, shipped in machine
- Across the line starter for oil pump, factory mounted
- Necessary labor for machine start up
- Complete set of machine drawings and wiring diagrams
- Bound operation and maintenance instructions
- Factory applied insulation of the cooler
- Neoprene isolation pads
- Flanged connections on all water nozzles
- Hot gas by-pass - automatic (electronic)
- Refrigerant isolation valves - for storage in condenser
- Star Delta closed transition starter - unit mounted
- Main power disconnect - circuit breaker
- Ammeter - 3 phase, mounted in starter door
- Voltmeter - 3 phase, mounted in starter door

## Page 2

- Control voltage transformer
- One year parts and labor warranty
- Freight to jobsite
- Flow switches

Among the items NOT included are:

- Rigging, carting or painting
- Labor to install
- Equipment base or pad
- Any piping or accessories except as noted above
- Refrigerant other than the initial charge
- Isolators
- Electrical work including power and control wiring

Our price for the above equipment FOB factory with freight allowed to jobsite is:(154 ton).....\$58,020.00

Our price for the above equipment FOB factory with freight allowed to jobsite is:(234 ton).....\$67,451.00

The price for equipment and materials as outlined is quoted FOB shipping point with freight allowed to jobsite. Terms of payment are net 30 days from date of invoice. We reserve the right to require payment in advance or COD or otherwise modify credit terms. In all other respects this quotation shall be subject to the terms and conditions of sale as outlined on the reverse side of page one of this quotation.

The price quoted does not include any sales, excise, or similar taxes, it being understood that any which apply are to be added at cost.

Work which is to be performed or materials which are to be furnished at Carrier's expense for completion of the proposed contract or fulfillment of warranty must be authorized by us and notice to proceed received prior to furnishing such service or material. Immediately upon completion of such work, the prenegotiated price would be invoiced through our office for immediate processing of a credit memo to be applied to your account. Inadvertent deductions from our invoices or backcharges for unauthorized work or materials will not be accepted.

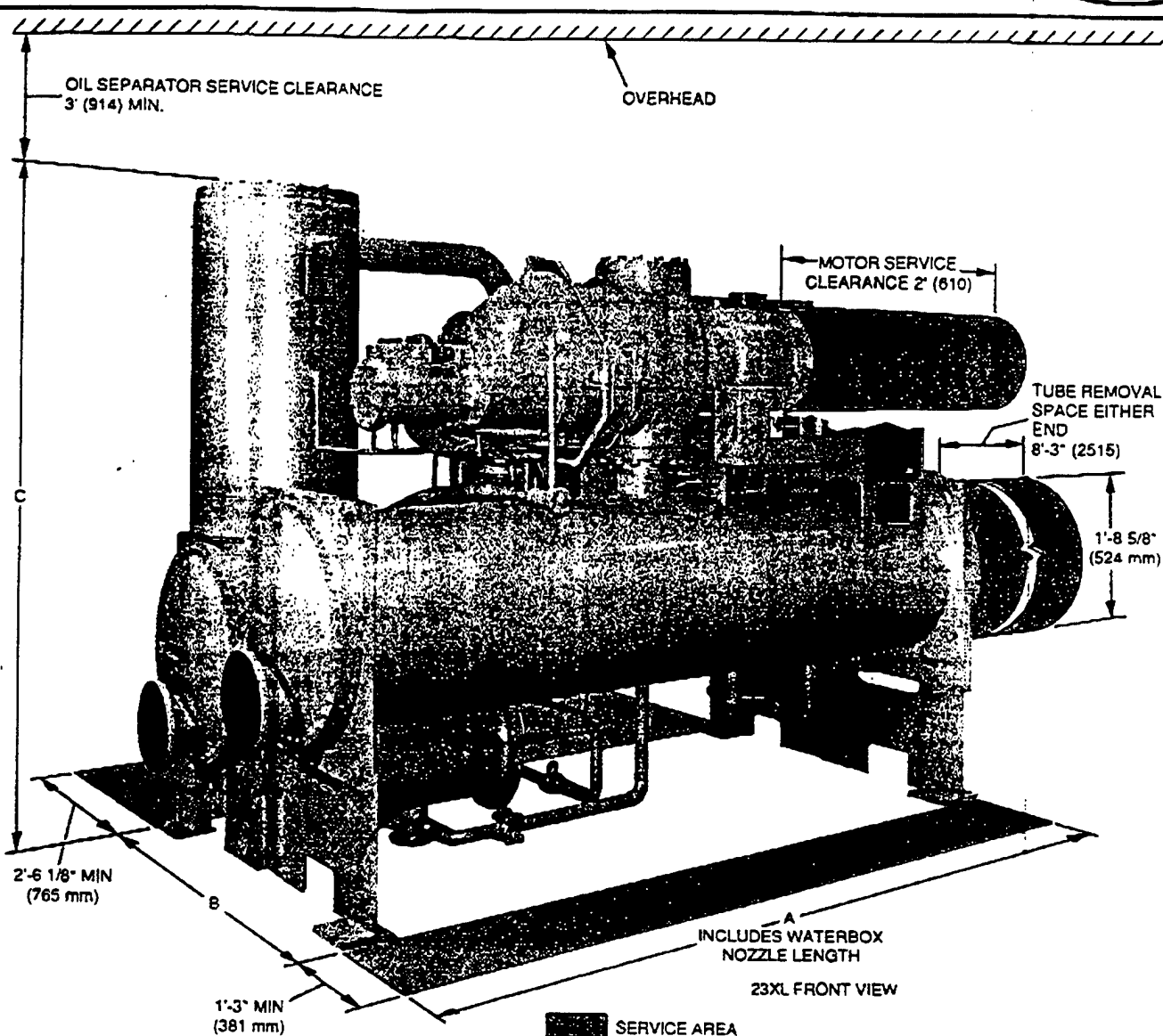
We appreciate your consideration of this quotation and would be pleased to discuss it in detail at your convenience.

Yours very truly,



Glen Brunkenhoefer  
Sales Engineer  
Carrier Corporation

# Dimensions



HEAT EXCHANGER SIZE	A (LENGTH)				B (WIDTH)		C (HEIGHT)		NOZZLE PIPE SIZE (in.)	
	1 Pass		2 and 3 Pass*						1-Pass	2 and 3-Pass
	ft-in.	mm	ft-in.	mm						
10 or 11	9-5	2870	9-6½	2908	4- 9½	1454	6- 9%	2073	8	6
20 or 21					4-11	1489	6-11%	2118	8	6

\*2 and 3-pass length applies if either (or both) cooler or condenser is a 2 or 3-pass design.

## NOTES:

1. Service access should be provided per ASHRAE 15 (American Society of Heating Refrigeration and Air Conditioning Engineers), Latest Edition, NFPA 70 (National Fire Protection Association) and local safety codes.
2. Allow at least 2 ft (610 mm) overhead clearance for service rigging.
3. Certified drawings available upon request.

DATE

09/16/93

JOB ID : FT. SAM HOUSTON

ANS PROBLEM	CH-1	CH-1	CH-1	CH-1
PLV %	100%	75%	50%	25%
ALTERNATES	FULLLOAD	PARTLOAD	PARTLOAD	PARTLOAD
UNIT-CLR-CND	23XL1011	23XL1011	23XL1011	23XL1011
COMPRESSOR	NC40	NC40	NC40	NC40
FLASC ORIFICE	33	33	33	33
CLR-CND PASS	3-3	3-3	3-3	3-3
CLR TUBING	TURBOBII	TURBOBII	TURBOBII	TURBOBII
CND/SUBC.TBG	SPIKEFIN	SPIKEFIN	SPIKEFIN	SPIKEFIN
VOLTS-HERTZ	208-60	208-60	208-60	208-60
REFR.NBR-LBS	22- 600	22- 600	22- 600	22- 600
COOLING TONS	154.0	115.5	77.0	38.5
CHILLER INPUT KW	103.8	71.7	48.1	29.0
IKW/TON	0.674	0.621	0.625	0.753
UNIT-MTD STARTER	Y-DELTA	Y-DELTA	Y-DELTA	Y-DELTA
TOTAL RIG.WT LB	9319	9319	9319	9319
TOTAL OP.WT LB	10653	10653	10653	10653
COOLER FLUID	FW	FW	FW	FW
ARI-550 FF	STD	STD	STD	STD
CLR ENT.TEMP F	54.00	51.49	48.99	46.50
CLR LVG.TEMP F	44.00	44.00	44.00	44.00
FLOW,U.S.GPM	369	369	369	369
PD, FT.W.G.	18.0	18.1	18.2	18.3
DNSR FLUID	FW	FW	FW	FW
.RJCTN MBH	2201	1630	1088	560
ARI-550 FF	STD	STD	STD	STD
CND LVG.TEMP F	94.58	85.84	77.22	68.68
CND ENT.TEMP F	85.00	78.75	72.50	66.25
FLOW,U.S.GPM	462	462	462	462
PD, FT.W.G.	12.2	12.4	12.7	12.9
MOTOR INPUT KW	103	71	48	29
RATED-L.AMPS	326	248	195	147
O.L.T.AMPS	352			
L.R.Y.AMPS	839	839	839	839
L.R.D.AMPS	2622	2622	2622	2622

IPLV 0.643

CERTIFIED IN ACCORDANCE WITH ARI 550-92

ON PROBLEM

CH-1

09/16/93

IPLV OR APLV CALCULATED PER ARI STANDARD 550-92

JOB ID : FT. SAM HOUSTON

DATE

09/16/93

ANS PROBLEM PLV % ALTERNATES	CH-1 100% FULLLOAD	CH-1 75% PARTLOAD	CH-1 50% PARTLOAD	CH-1 25% PARTLOAD
UNIT-CLR-CND	23XL2020	23XL2020	23XL2020	23XL2020
COMPRESSOR	EC60	EC60	EC60	EC60
FLASC ORIFICE	36	36	36	36
CLR-CND PASS	3-3	3-3	3-3	3-3
CLR TUBING	TURBOBII	TURBOBII	TURBOBII	TURBOBII
CND/SUBC.TBG	SPIKEFIN	SPIKEFIN	SPIKEFIN	SPIKEFIN
VOLTS-HERTZ	208-60	208-60	208-60	208-60
REFR.NBR-LBS	22- 750	22- 750	22- 750	22- 750
COOLING TONS	234.0	175.5	117.0	58.5
CHILLER INPUT KW	147.9	95.2	63.5	35.6
IKW/TON	0.632	0.542	0.543	0.609
UNIT-MTD STARTER	Y-DELTA	Y-DELTA	Y-DELTA	Y-DELTA
TOTAL RIG.WT LB	10329	10329	10329	10329
TOTAL OP.WT LB	11949	11949	11949	11949
COOLER FLUID	FW	FW	FW	FW
ARI-550 FF	STD	STD	STD	STD
CLR ENT.TEMP F	54.00	51.49	48.99	46.50
CLR LVG.TEMP F	44.00	44.00	44.00	44.00
FLOW,U.S.GPM	561	561	561	561
PD, FT.W.G.	22.9	23.0	23.1	23.2
DNSR FLUID	FW	FW	FW	FW
.RJCTN MBH	3313	2431	1620	823
ARI-550 FF	STD	STD	STD	STD
CND LVG.TEMP F	94.49	85.71	77.13	68.60
CND ENT.TEMP F	85.00	78.75	72.50	66.25
FLOW,U.S.GPM	702	702	702	702
PD, FT.W.G.	22.8	23.2	23.6	24.1
MOTOR INPUT KW	147	95	63	35
RATED-L.AMPS	449	317	247	179
O.L.T.AMPS	485			
L.R.Y.AMPS	810	810	810	810
L.R.D.AMPS	2531	2531	2531	2531

IPLV 0.563

CERTIFIED IN ACCORDANCE WITH ARI 550-92

ON PROBLEM

CH-1

09/16/93

IPLV OR APLV CALCULATED PER ARI STANDARD 550-92





## CENTRIFUGAL MACHINE DATA

## MACHINE

 MODEL 19DA-160  
 S/N 82412763
Job Name FT. SAN HOUSTONJob No. 8660E6001Location SAN ANTONIO, TEXASApplication NON-COMMISSIONED OFFICERS MESS DARI-2092

## OPERATING DATA

	BRINE	GPM	°F IN	°F OUT	TONS	SUCT. °F	COND. °F	REFRIG
COOLER	WATER	369	54	44	154	35.7	—	R-1
CONDENSER	WATER	462	85	94.7	—	—	102.5	—

## COMPRESSOR

P/N

S/N

MODEL	<u>235</u>	STATOR: <u>19DA23-1724F</u>	<u>269757</u>
S/N	<u>23035</u>	ROTOR: <u>19D23-1224</u>	<u>269757</u>
IMPELLER NO.	<u>19D23-1054</u>	SHAFT: <u>19DA21</u>	<u>38525</u>
MOTOR	Size <u>C-2-T</u>		
	Volts/FLA <u>208/433</u>	<u>OIL PUMP 208-3-60</u>	

## HEAT EXCHANGERS

	SIZE	PASS	S/N	PD	WORKING PRESS.	TUBE SHEET MATL.	TUBE MATL.
COOLER	<u>21</u>	<u>2</u>	<u>27898</u>	<u>14'</u>	<u>150</u>		
COND.		<u>2</u>		<u>18'</u>	<u>150</u>		

## OTHER COMPONENTS

	TYPE	MFG.	RPM	S/N
CONSOLE	<u>19DA11-504</u>		<u>XXXXX</u>	<u>28014</u>
PURGE			<u>XXXXX</u>	
CONTROLS	<u>ELECTRIC</u>	<u>BC</u>	<u>XXXXX</u>	
STARTER	<u>ADAOT.</u>	<u>CH</u>	<u>XXXXX</u>	
GEAR			<u>1</u>	
DRIVER				
COUPLINGS	COMPRESSOR	SPACER	PINION	GEAR
Size				
Part No.				

DATE SHIPPED: 6-18-68 "T"WARRANTY EXP: 1-1-70
 R-11; ~~9.1~~ 9.1 kW/TON @ 100%, 1.1 kW/TON @ 50%; DERATE @  
 .75%/YEAR OR 1.12 kW/TON @ 100%, 1.35 kW/TON @ 50%

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1395 - ECO IV. D. 1) - REPLACE CHILLER W/ HIGHER EFF/CFC FREE CHILLER  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	<u>\$142,836</u>	
B. SIOH	<u>\$7,856</u>	
C. DESIGN COST	<u>\$8,570</u>	
D. TOTAL COST (1A+1B+1C)	<u>\$159,262</u>	
E. SALVAGE VALUE OF EXISTING EQUIPMENT		<u>\$0</u>
F. PUBLIC UTILITY COMPANY REBATE		<u>\$0</u>
G. TOTAL INVESTMENT (1D-1E-1F)		<u>\$159,262</u>

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	<u>\$10.55</u>	<u>419.87</u>	<u>\$4,430</u>	<u>14.65</u>	<u>\$64,894</u>
B. DIST			<u>\$0</u>	<u>17.70</u>	<u>\$0</u>
C. RESID			<u>\$0</u>	<u>20.99</u>	<u>\$0</u>
D. NG	<u>\$3.31</u>	<u>0.00</u>	<u>\$0</u>	<u>20.60</u>	<u>\$0</u>
E. PPG			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
F. COAL			<u>\$0</u>	<u>16.32</u>	<u>\$0</u>
G. SOLAR			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
H. GEOTH			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
I. BIOMA			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
J. REFUS			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
K. WIND			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
L. OTHER			<u>\$0</u>	<u>13.59</u>	<u>\$0</u>
M. DEMAND SAVINGS			<u>\$7,872</u>	<u>13.59</u>	<u>\$106,980</u>
N. TOTAL		<u>419.87</u>	<u>\$12,302</u>		<u>\$171,875</u>

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	<u>\$0</u>
1. DISCOUNT FACTOR (TABLE A)	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)	<u>\$0</u>

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. WC Chiller	\$90,080	1	0.96	\$86,477
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. AC Chiller	\$51,000	13	0.6	\$30,600
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$141,080			\$117,077

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$117,077

4. SIMPLE PAYBACK  $1G / (2N3 + 3A + (3Bp1 / \text{ECONOMIC LIFE}))$ : 8.2 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$288,951

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 1.81

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.1%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1395

ECO NO: VII D & IX A, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>42,637.0</u>	KWH/yr
Demand Savings:	<u>53.7</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 2,179</u>	/yr
Implementation Cost:	<u>\$ 4,850</u>	
Simple Payback:	<u>2.2</u>	Years
Savings to Investment: Ratio (SIR):	<u>5.08</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
80	2-Lamp, 4' Fluor.	Retrofit w/T8 lamps and elect. ballasts.
9	Incandescent chandelier	None.
45	Incandescent chandelier	Retrofit w/compact fluor. lamps.
14	Misc. incandescent	None.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned} \text{Demand Savings} &= (14.053 \text{ KW} - 9.578 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (14.053 \text{ KW} - 9.578 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$358/\text{yr} \end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cnts/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD1395A	38599	42161	112787	8299	18035	9.693	0.187	4350	16853	91585	1240	6739
*BLD1395B	56634	0	154949	11401	0	0.000	0.000	0	20744	134204	1526	9875

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD1395A	POST RETROFIT CONDITIONS
BLD1395B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395A.WBR  
 Date: 10/16/1993

Lighting Annual : 38599 kWh  
 Lighting Capacity : 9.578 kW  
 Annual Cooling Effect : 52953 kWh  
 Annual Heating Effect : 5514 kWh  
 Total Surveyed Floor Area: 5984 SqFt  
 Percent Survey Completed : 598400 %  
 Lighting Power Density : 1.601 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	4350	40836	16853	51695	-946	112787
AVLCC \$	320	3005	1240	3804	-70	8299

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395A.LLR  
 Date: 10/16/1993

Room Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	73.2	5.4	25.4	27.56	1-kitchen	2-dry stor
Measured	56.2	3.9	16.1	22.51	1-kitchen	3-scullyery
Required	50.0	5.0	24.0	23.76	1-kitchen	2-dry stor

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	23.2	-25.8	1.4	17.64	1-kitchen	3-scullyery
Meas - Req.	6.2	-46.1	-7.9	21.53	1-kitchen	3-scullyery



Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395A.LSR  
Date: 10/16/1993

System Number: 1      Descr: open fluor.

Rooms Served: 1  
Floor Area: 2160 SqFt  
Possible kW: 3.831  
Working kW: 3.831  
Capacity kW: 3.831  
Lighting: 15438 Annual kWh  
Heating: 2205 Annual kWh  
Cooling: 21299 Annual kWh  
Op Hours/Year: 4030 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 90.2 Months  
Power Density: 1.774 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	61	122	61.0
Working	61	122	61.0
Capacity	61	122	61.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	16333	2146	20824	-378	41426
AVLCC \$	1202	158	1532	-28	3048

System Number: 2      Descr: 4' fluor. surf. acrylic lens

Rooms Served: 1  
Floor Area: 2160 SqFt  
Possible kW: 0.942  
Working kW: 0.942  
Capacity kW: 0.942  
Lighting: 3796 Annual kWh  
Heating: 542 Annual kWh  
Cooling: 5238 Annual kWh  
Op Hours/Year: 4030 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 90.2 Months  
Power Density: 0.436 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	15	30	15.0
Working	15	30	15.0
Capacity	15	30	15.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4016	528	5121	-93	10187
AVLCC \$	296	39	377	-7	750

System Number: 3      Descrip: incand. chandelier

Rooms Served: 1  
 Floor Area: 2640 SqFt  
 Possible kW: 1.200  
 Working kW: 1.075  
 Capacity kW: 1.200  
 Lighting: 4836 Annual kWh  
 Heating: 691 Annual kWh  
 Cooling: 6672 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 7.4 Months  
 Power Density: 0.407 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	48	0.0
Working	6	43	0.0
Capacity	6	48	0.0
Disconnected	0	0	0.0
Broken/Burned	0	5	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5116	3189	6523	-119	14710
AVLCC \$	376	235	480	-9	1082

System Number: 4      Descrip: rec. incand.

Rooms Served: 2  
 Floor Area: 3680 SqFt  
 Possible kW: 2.340  
 Working kW: 1.980  
 Capacity kW: 2.340  
 Lighting: 9430 Annual kWh  
 Heating: 1347 Annual kWh  
 Cooling: 12657 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 3.0 Months  
 Power Density: 0.538 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	39	39	0.0
Working	39	33	0.0
Capacity	39	39	0.0
Disconnected	0	0	0.0
Broken/Burned	0	6	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	9977	6104	12284	-231	28133
AVLCC \$	734	449	904	-17	2070

System Number: 5      Descrip: spotlight W/ PL

Rooms Served: 1  
 Floor Area: 2640 SqFt  
 Possible kW: 0.048  
 Working kW: 0.048  
 Capacity kW: 0.048  
 Lighting: 193 Annual kWh  
 Heating: 28 Annual kWh  
 Cooling: 260 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 40.6 Months  
 Power Density: 0.018 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	2.0
Working	2	2	2.0
Capacity	2	2	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	205	226	252	-5	722
AVLCC \$	15	17	19	-0	53

System Number: 6      Descrip: incand. Chandelier

Rooms Served: 1  
 Floor Area: 1040 SqFt  
 Possible kW: 1.200  
 Working kW: 1.200  
 Capacity kW: 1.200  
 Lighting: 4836 Annual kWh  
 Heating: 691 Annual kWh  
 Cooling: 6672 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 6.0 Months  
 Power Density: 1.154 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	24	0.0
Working	3	24	0.0
Capacity	3	24	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5116	3008	6523	-119	14651
AVLCC \$	376	221	480	-9	1078

System Number: 7      Descrip: decorative sconce

Rooms Served: 1  
 Floor Area: 1040 SqFt  
 Possible kW: 0.225  
 Working kW: 0.225  
 Capacity kW: 0.225  
 Lighting: 907 Annual kWh  
 Heating: 130 Annual kWh  
 Cooling: 1251 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 7.4 Months  
 Power Density: 0.216 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	9	0.0
Working	3	9	0.0
Capacity	3	9	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	959	598	1223	-22	2776
AVLCC \$	71	44	90	-2	204

System Number: 8      Descrip: incand. gask hood

Rooms Served: 1  
 Floor Area: 2160 SqFt  
 Possible kW: 1.000  
 Working kW: 1.000  
 Capacity kW: 1.000  
 Lighting: 4030 Annual kWh  
 Heating: 576 Annual kWh  
 Cooling: 5409 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 2.2 Months  
 Power Density: 0.463 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	10	0.0
Working	10	10	0.0
Capacity	10	10	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4264	2087	5250	-99	11518
AVLCC \$	314	154	386	-7	847

System Number: 9      Descrip: keyless incand.

Rooms Served: 1  
 Floor Area: 48 SqFt  
 Possible kW: 0.100  
 Working kW: 0.100  
 Capacity kW: 0.100  
 Lighting: 403 Annual kWh  
 Heating: 58 Annual kWh  
 Cooling: 556 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 2.2 Months  
 Power Density: 2.083 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	426	209	544	-10	1170
AVLCC \$	31	15	40	-1	86

System Number: 10      Descrip: incand. down light W/ PL

Rooms Served: 1  
 Floor Area: 96 SqFt  
 Possible kW: 0.096  
 Working kW: 0.096  
 Capacity kW: 0.096  
 Lighting: 387 Annual kWh  
 Heating: 55 Annual kWh  
 Cooling: 534 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 40.6 Months  
 Power Density: 1.000 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	4	4.0
Working	4	4	4.0
Capacity	4	4	4.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	409	452	522	-9	1461
AVLCC \$	30	33	38	-1	108

Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM2 Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Watt Meas. FootC	Calc. FootC	Req. FootC		
1-kitchen	1	1	2160	4 open fluor	3831	3831	1.77	4' fluor.	942	942	0.44	incand. ga	1000	1000	0.46	5773	2.67	56.2	73.2	50.0
2-dry stor	1	1	48	0 keyless in	100	100	2.08									100	2.08	4.8	5.4	5.0
3-sculery	1	1	96	0 incand. do	96	96	1.00									96	1.00	3.9	24.2	50.0
4-dining	1	1	2640	300 PL DOWNLIG	672	672	0.25	incand. ch	1200	1200	0.45	spotlight	48	48	0.02	1920	0.73	7.9	10.3	7.5
5-dining	1	1	1040	100 PL DOWNLIG	264	264	0.25	incand. ch	1200	1200	1.15	decorative	225	225	0.22	1689	1.62	7.6	14.2	7.5

Total Rooms : 5  
 Total Area Sqft : 5984  
 Total People : 404  
 Total Working kW : 9.578  
 Total Potential kW : 9.578  
 Power Density W/sqft : 1.601

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395B.WBR

Date: 10/16/1993

Lighting Annual : 56634 kWh  
 Lighting Capacity : 14.053 kW  
 Annual Cooling Effect : 77555 kWh  
 Annual Heating Effect : 8091 kWh  
 Total Surveyed Floor Area: 5984 SqFt  
 Percent Survey Completed : 598400 %  
 Lighting Power Density : 2.348 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	0	59916	20744	75677	-1388	154949
AVLCC \$	0	4409	1526	5568	-102	11401

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1395\BLD1395B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: open fluor.

Rooms Served: 1  
Floor Area: 2160 SqFt  
Possible kW: 6.048  
Working kW: 5.520  
Capacity kW: 6.048  
Lighting: 24373 Annual kWh  
Heating: 3482 Annual kWh  
Cooling: 33627 Annual kWh  
Op Hours/Year: 4030 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 90.2 Months  
Power Density: 2.556 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	63	126	63.0
Working	61	115	57.0
Capacity	63	126	63.0
Disconnected	0	0	0.0
Broken/Burned	2	7	5.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	25786	3606	32877	-597	61672
AVLCC \$	1897	265	2419	-44	4538

System Number: 2      Descrip: 4' fluor. surf. acrylic lens

Rooms Served: 1  
Floor Area: 2160 SqFt  
Possible kW: 1.440  
Working kW: 1.248  
Capacity kW: 1.632  
Lighting: 5803 Annual kWh  
Heating: 829 Annual kWh  
Cooling: 8006 Annual kWh  
Op Hours/Year: 4030 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 90.2 Months  
Power Density: 0.578 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	15	30	15.0
Working	15	26	13.0
Capacity	17	34	17.0
Disconnected	2	0	2.0
Broken/Burned	0	4	2.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	6140	859	7828	-142	14684
AVLCC \$	452	63	576	-10	1080



System Number: 3      Descrip: incand. chandelier

Rooms Served: 1  
 Floor Area: 2640 SqFt  
 Possible kW: 1.200  
 Working kW: 1.200  
 Capacity kW: 1.200  
 Lighting: 4836 Annual kWh  
 Heating: 691 Annual kWh  
 Cooling: 6672 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 7.4 Months  
 Power Density: 0.455 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	48	0.0
Working	6	48	0.0
Capacity	6	48	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5116	3189	6523	-119	14806
AVLCC \$	376	235	480	-9	1089

System Number: 4      Descrip: PL DOWNLIGHT

Rooms Served: 2  
 Floor Area: 3680 SqFt  
 Possible kW: 0.936  
 Working kW: 0.936  
 Capacity kW: 0.936  
 Lighting: 3772 Annual kWh  
 Heating: 539 Annual kWh  
 Cooling: 5063 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 40.6 Months  
 Power Density: 0.254 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	39	39	39.0
Working	39	39	39.0
Capacity	39	39	39.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3991	4410	4914	-92	14071
AVLCC \$	294	325	362	-7	1035

System Number: 5      Descrip: spotlight

Rooms Served: 1  
 Floor Area: 2640 SqFt  
 Possible kW: 0.100  
 Working kW: 0.100  
 Capacity kW: 0.100  
 Lighting: 403 Annual kWh  
 Heating: 58 Annual kWh  
 Cooling: 541 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 6.0 Months  
 Power Density: 0.038 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	0.0
Working	2	2	0.0
Capacity	2	2	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	426	251	525	-10	1192
AVLCC \$	31	18	39	-1	88

System Number: 6      Descrip: incand. Chandelier

Rooms Served: 1  
 Floor Area: 1040 SqFt  
 Possible kW: 1.200  
 Working kW: 1.000  
 Capacity kW: 1.200  
 Lighting: 4836 Annual kWh  
 Heating: 691 Annual kWh  
 Cooling: 6672 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 6.0 Months  
 Power Density: 0.962 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	24	0.0
Working	3	20	0.0
Capacity	3	24	0.0
Disconnected	0	0	0.0
Broken/Burned	0	4	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5116	3008	6523	-119	14529
AVLCC \$	376	221	480	-9	1069

System Number: 7      Descrip: decorative sconce

Rooms Served: 1  
 Floor Area: 1040 SqFt  
 Possible kW: 0.225  
 Working kW: 0.200  
 Capacity kW: 0.225  
 Lighting: 907 Annual kWh  
 Heating: 130 Annual kWh  
 Cooling: 1251 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 7.4 Months  
 Power Density: 0.192 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	3	9	0.0
Working	3	8	0.0
Capacity	3	9	0.0
Disconnected	0	0	0.0
Broken/Burned	0	1	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	959	598	1223	-22	2758
AVLCC \$	71	44	90	-2	203

System Number: 8      Descrip: incand. gask hood

Rooms Served: 1  
 Floor Area: 2160 SqFt  
 Possible kW: 1.000  
 Working kW: 1.000  
 Capacity kW: 1.000  
 Lighting: 4030 Annual kWh  
 Heating: 576 Annual kWh  
 Cooling: 5409 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 2.2 Months  
 Power Density: 0.463 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	10	0.0
Working	10	10	0.0
Capacity	10	10	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	4264	2087	5250	-99	11501
AVLCC \$	314	154	386	-7	846

System Number: 9      Descrip: keyless incand.

Rooms Served: 1  
 Floor Area: 48 SqFt  
 Possible kW: 0.100  
 Working kW: 0.100  
 Capacity kW: 0.100  
 Lighting: 403 Annual kWh  
 Heating: 58 Annual kWh  
 Cooling: 556 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 2.2 Months  
 Power Density: 2.083 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	426	209	544	-10	1169
AVLCC \$	31	15	40	-1	86

System Number: 10      Descrip: incand. down light

Rooms Served: 1  
 Floor Area: 96 SqFt  
 Possible kW: 0.400  
 Working kW: 0.400  
 Capacity kW: 0.400  
 Lighting: 1612 Annual kWh  
 Heating: 230 Annual kWh  
 Cooling: 2164 Annual kWh  
 Op Hours/Year: 4030 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 2.2 Months  
 Power Density: 4.167 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	4	0.0
Working	4	4	0.0
Capacity	4	4	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1705	835	2100	-40	4600
AVLCC \$	125	61	155	-3	339

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1395 - ECO VII D. & IX A., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$4,350		
B. SIOH	\$239		
C. DESIGN COST	\$261		
D. TOTAL COST (1A+1B+1C)	\$4,850		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$4,850

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	61.55	\$649	11.77	\$7,643
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	83.97	\$886	11.12	\$9,851
M. DEMAND SAVINGS			\$358	11.12	\$3,981
N. TOTAL		145.52	\$1,893		\$21,475

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$286		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$3,175

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$3,175

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 2.2 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$24,649

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 5.08

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 15.9%

## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 1462 - SNACK BAR**

Building 1462 is a two story block wall facility consisting of 16,000 square feet. This facility contains a 1,300 square feet snack bar area.

The operating hours for this facility are from 9:00 am to 8:30 pm, Sunday thru Thursday and 9:00 am to 10:30 pm, Friday and Saturday.

The lighting system is primarily fluorescent.

The mechanical system consists of an single zone air handling unit served by an air cooled chiller. Heating is provided by a gas fired boiler.

Hot water is provided to the kitchen by a gas fired water heater. Dishwashing is done by hand using a rinse sink with an electric hot water booster heater.

The following ECO's are recommended for Building 1462:

1. VII. D - Reduce indoor/outdoor lighting to AEI levels
2. IX. B - Replace incandescent exit fixtures with LED
3. IX. C - Replace standard lamps with energy saving lamps
4. IX. D - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1462

ECO NO: VII D & IX B, C, D

ECO NAME: Improve lighting efficiency

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>8.760</u>	KWH/yr
Demand Savings:	<u>15.38</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 455</u>	/yr
Implementation Cost:	<u>\$ 1,037</u>	
Simple Payback:	<u>2.3</u>	Years
Savings to Investment: Ratio (SIR):	<u>4.96</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
2	2-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
16	4-Lamp, 4" Fluor.	Retrofit w/T8 lamps and electronic ballasts.
2	Incand. Exit	Replace w/LED exit fixture.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)



$$\begin{aligned}\text{Demand Savings} &= (3.264 \text{ KW} - 1.982 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (3.264 \text{ KW} - 1.982 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$102.56/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cts/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD1462A	5697	9627	17071	1256	3687	10.351	0.828	930	620	15522	46	1142
*BLD1462B	9384	0	26698	1964	0	0.000	0.000	0	1135	25563	83	1881

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD1462A	POST RETROFIT CONDITIONS
BLD1462B	EXISTING CONDITIONS

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Whole Building Summary Report
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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462A.WBR  
 Date: 10/16/1993

Lighting Annual : 5697 kWh  
 Lighting Capacity : 1.982 kW  
 Annual Cooling Effect : 7843 kWh  
 Annual Heating Effect : 814 kWh  
 Total Surveyed Floor Area: 1344 SqFt  
 Percent Survey Completed : 134400 %  
 Lighting Power Density : 1.474 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	930	6664	620	8998	-140	17071
AVLCC \$	68	490	46	662	-10	1256

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462A.LLR  
 Date: 10/16/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	49.2	25.0	35.8	12.27	2-kitchen	3-stor
Measured	79.1	8.2	42.6	35.49	1-dining	3-stor
Required	50.0	5.0	20.0	25.98	2-kitchen	1-dining

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	28.4	-0.8	15.8	15.06	1-dining	2-kitchen
Meas - Req.	74.1	-9.5	22.6	45.03	1-dining	2-kitchen

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 2x4 lay in 4 lamp

Rooms Served: 2  
Floor Area: 1260 SqFt  
Possible kW: 1.856  
Working kW: 1.856  
Capacity kW: 1.856  
Lighting: 5336 Annual kWh  
Heating: 762 Annual kWh  
Cooling: 7335 Annual kWh  
Op Hours/Year: 2875 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 120.1 Months  
Power Density: 1.473 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	16	64	16.0
Working	16	64	16.0
Capacity	16	64	16.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	6241	572	8402	-131	15933
AVLCC \$	459	42	618	-10	1172

System Number: 2      Descrip: 4' strip

Rooms Served: 1  
Floor Area: 84 SqFt  
Possible kW: 0.126  
Working kW: 0.126  
Capacity kW: 0.126  
Lighting: 361 Annual kWh  
Heating: 52 Annual kWh  
Cooling: 508 Annual kWh  
Op Hours/Year: 2875 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 120.1 Months  
Power Density: 1.495 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	422	47	596	-9	1138
AVLCC \$	31	3	44	-1	84

Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	SYSTEM1	Work	Pot.	Watt SYSTEM2	Work	Pot.	Watt SYSTEM3	Work	Pot.	Watt	Work	Pot.	Watt Meas.	Calc. Req.
			* Area	#Pr Name	Watts	Watts	sqft Name	Watts	Watts	sqft Name	Watts	Watts	sqft	Watts	Watts	FootC	FootC
1-dining	1	1	756	20 2x4 lay in	928	928	1.23							928	928	1.23	79.1
2-kitchen	1	1	504	3 2x4 lay in	928	928	1.84							928	928	1.84	40.5
3-stor	10	1	84	0 4' strip	126	126	1.50							126	126	1.50	8.2
																	25.0
																	5.0

Total Rooms : 3  
 Total Area Sqft : 1344  
 Total People : 23  
 Total Working kW : 1.982  
 Total Potential kW : 1.982  
 Power Density W/sqft : 1.474

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462B.WBR  
 Date: 10/16/1993

Lighting Annual : 9384 kWh  
 Lighting Capacity : 3.264 kW  
 Annual Cooling Effect : 12917 kWh  
 Annual Heating Effect : 1341 kWh  
 Total Surveyed Floor Area: 1344 SqFt  
 Percent Survey Completed : 134400 %  
 Lighting Power Density : 2.429 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	0	10976	1135	14817	-230	26698
AVLCC \$	0	808	83	1090	-17	1964

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Lighting System Survey Summary

One Page for Each Defined System

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1462\BLD1462B.LSR  
 Date: 10/16/1993

System Number: 1      Descip: 2x4 lay in 4 lamp

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Rooms Served: 2  
 Floor Area: 1260 SqFt  
 Possible kW: 3.072  
 Working kW: 3.072  
 Capacity kW: 3.072  
 Lighting: 8832 Annual kWh  
 Heating: 1262 Annual kWh  
 Cooling: 12141 Annual kWh  
 Op Hours/Year: 2875 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 120.1 Months  
 Power Density: 2.438 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	16	64	16.0
Working	16	64	16.0
Capacity	16	64	16.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	10331	1056	13907	-217	25077
AVLCC \$	760	78	1023	-16	1845

System Number: 2      Descip: 4' strip

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Rooms Served: 1  
 Floor Area: 84 SqFt  
 Possible kW: 0.192  
 Working kW: 0.192  
 Capacity kW: 0.192  
 Lighting: 552 Annual kWh  
 Heating: 79 Annual kWh  
 Cooling: 776 Annual kWh  
 Op Hours/Year: 2875 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 120.1 Months  
 Power Density: 2.286 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	646	79	911	-14	1621
AVLCC \$	48	6	67	-1	119



# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1462 - ECO VII D. & IX B., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$930		
B. SIOH	\$51		
C. DESIGN COST	\$56		
D. TOTAL COST (1A+1B+1C)	\$1,037		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$1,037

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	12.58	\$133	11.77	\$1,562
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	17.32	\$183	11.12	\$2,032
M. DEMAND SAVINGS			\$103	11.12	\$1,140
N. TOTAL		29.9	\$418		\$4,734

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$37		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$411

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$411

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 2.3 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$5,145

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 4.96

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 15.7%

## ENERGY CONSERVATION ANALYSIS

### BUILDING 1520 - RESERVE CENTER

Building 1520 is a two story brick facility consisting of reserve unit offices. This facility contains a full service kitchen and large dining area which consists of 4,300 square feet.

The operating hours for the dining and kitchen facility are very sporadic due to the fact that it is used only for mobilization. However, the dining area is used as a break room and from 8:00 am to 4:00 pm the lights are on.

The lighting system is primarily fluorescent.

The mechanical system consists of a packaged DX rooftop air handling unit with gas heating.

Hot water is provided to the kitchen by a gas fired water heater.

Due to the operating conditions for this facility are as follows:

1. VII.D - Reduce indoor/outdoor lighting to AEI levels.
2. IX.A - Replace incandescent lamps with compact fluorescents.
3. IX.B. - Replace incandescent exit fixtures with LED.
4. IX.C. - Replace standard lamps with energy saving lamps.
5. IX.D. - Replace standard ballast with energy saving ballast.

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 1520

ECO NO: VII D & IX A, B, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>12,030</u>	KWH/yr
Demand Savings:	<u>26.76</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 664</u>	/yr
Implementation Cost:	<u>\$ 2,447</u>	
Simple Payback:	<u>3.7</u>	Years
Savings to Investment: Ratio (SIR):	<u>3.06</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
15	2-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
30	3-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
4	Incand. Exit	Replace w/LED exit fixture.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned} \text{Demand Savings} &= (5.91 \text{ KW} - 3.68 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (5.91 \text{ KW} - 3.68 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$178.40/\text{yr} \end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value LCC \$	Annual Value LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value LCC \$	Present Value Energy LCC \$	Annual Value Energy LCC \$
BLD1520A	8275	13373	27685	2037	5022	6.093	2.176	2195	977	24512	1804
*BLD1520B	13297	0	41058	3021	0	0.000	0.000	0	1687	39371	2897

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD1520A	POST RETROFIT CONDITIONS
BLD1520B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520A.WBR

Date: 10/16/1993

Lighting Annual : 8275 kWh  
 Lighting Capacity : 3.678 kW  
 Annual Cooling Effect : 11556 kWh  
 Annual Heating Effect : 1182 kWh  
 Total Surveyed Floor Area: 4268 SqFt  
 Percent Survey Completed : 426800 %  
 Lighting Power Density : 0.862 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2195	10576	977	14139	-203	27685
AVLCC \$	162	778	72	1040	-15	2037

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520A.LLR

Date: 10/16/1993

Room	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Foot Candles						
-----	-----	-----	-----	-----	-----	-----
Calculated	53.3	15.4	35.0	15.59	4-scullyery	1-multi use/dinig
Measured	44.8	30.6	36.8	6.09	4-scullyery	1-multi use/dinig
Required	50.0	5.0	27.5	25.98	3-kitchen	1-multi use/dinig

Room	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Foot Candle						
Comparison						
-----	-----	-----	-----	-----	-----	-----
Calc - Req.	28.2	-12.0	7.5	16.71	2-stor	3-kitchen
Meas - Req.	29.1	-12.2	9.3	21.06	2-stor	3-kitchen



Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 4 lamp, 2x4 lay-in

Rooms Served: 1  
Floor Area: 3500 SqFt  
Possible kW: 2.736  
Working kW: 2.736  
Capacity kW: 2.736  
Lighting: 6156 Annual kWh  
Heating: 879 Annual kWh  
Cooling: 8556 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.782 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	30	90	30.0
Working	30	90	30.0
Capacity	30	90	30.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	7867	698	10358	-151	20242
AVLCC \$	579	51	762	-11	1489

System Number: 2      Descrip: 4' industrual

Rooms Served: 1  
Floor Area: 144 SqFt  
Possible kW: 0.126  
Working kW: 0.126  
Capacity kW: 0.126  
Lighting: 283 Annual kWh  
Heating: 40 Annual kWh  
Cooling: 400 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.872 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	361	35	504	-7	976
AVLCC \$	27	3	37	-1	72

System Number: 3      Descrip: fluor wrap

Rooms Served: 1  
 Floor Area: 336 SqFt  
 Possible kW: 0.440  
 Working kW: 0.440  
 Capacity kW: 0.440  
 Lighting: 989 Annual kWh  
 Heating: 141 Annual kWh  
 Cooling: 1400 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 1.308 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	7	14	7.0
Working	7	14	7.0
Capacity	7	14	7.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1264	124	1765	-24	3416
AVLCC \$	93	9	130	-2	251

System Number: 4      Descrip: 1x4 surface w/acrylic lens

Rooms Served: 2  
 Floor Area: 3788 SqFt  
 Possible kW: 0.377  
 Working kW: 0.377  
 Capacity kW: 0.377  
 Lighting: 848 Annual kWh  
 Heating: 121 Annual kWh  
 Cooling: 1200 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 0.099 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	12	6.0
Working	6	12	6.0
Capacity	6	12	6.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1083	120	1513	-21	3051
AVLCC \$	80	9	111	-2	225

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| Room-By-Room Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	#Pr	SYSTEM1 Name	Work Watts	Pot. Watts	Watt SYSTEM2 Name	Work Watts	Pot. Watts	Watt SYSTEM3 Name	Work Watts	Pot. Watts	Watt Work	Pot. Watts	Watt Meas. FootC	Calc. Req. FootC
1-multi use	1	1	3500	100	4 lamp, 2x	2736	2736	0.78 1x4 surfac	63	63	0.02	2799	2799	0.80	30.6	15.4	5.0
2-stor	1	1	144	0	4' industr	126	126	0.87				126	126	0.87	34.1	33.2	5.0
3-kitchen	1	1	288	2	1x4 surfac	314	314	1.09				314	314	1.09	37.8	38.0	50.0
4-scultery	1	1	336	2	fluor wrap	440	440	1.31				440	440	1.31	44.8	53.3	50.0

Total Rooms : 4  
 Total Area Sqft : 4268  
 Total People : 104  
 Total Working kW : 3.678  
 Total Potential kW : 3.678  
 Power Density W/sqft : 0.862

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520B.WBR  
 Date: 10/16/1993

Lighting Annual : 13297 kWh  
 Lighting Capacity : 5.910 kW  
 Annual Cooling Effect : 18565 kWh  
 Annual Heating Effect : 1900 kWh  
 Total Surveyed Floor Area: 4268 SqFt  
 Percent Survey Completed : 426800 %  
 Lighting Power Density : 1.385 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	0	16994	1687	22703	-326	41058
AVLCC \$	0	1250	124	1671	-24	3021

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1520\BLD1520B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 3 lamp, 2x4 lay-in

Rooms Served: 1  
Floor Area: 3500 SqFt  
Possible kW: 4.470  
Working kW: 2.682  
Capacity kW: 4.470  
Lighting: 10058 Annual kWh  
Heating: 1437 Annual kWh  
Cooling: 13978 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 0.766 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	30	90	30.0
Working	20	54	18.0
Capacity	30	90	30.0
Disconnected	0	0	0.0
Broken/Burned	10	6	12.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	12853	1240	16923	-247	30769
AVLCC \$	946	91	1245	-18	2264

System Number: 2      Descrip: 4' industrual

Rooms Served: 1  
Floor Area: 144 SqFt  
Possible kW: 0.192  
Working kW: 0.192  
Capacity kW: 0.192  
Lighting: 432 Annual kWh  
Heating: 62 Annual kWh  
Cooling: 612 Annual kWh  
Op Hours/Year: 2250 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 142.1 Months  
Power Density: 1.333 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	552	60	771	-11	1372
AVLCC \$	41	4	57	-1	101

System Number: 3      Descrip: fluor wrap

Rooms Served: 1  
 Floor Area: 336 SqFt  
 Possible kW: 0.672  
 Working kW: 0.624  
 Capacity kW: 0.672  
 Lighting: 1512 Annual kWh  
 Heating: 216 Annual kWh  
 Cooling: 2141 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 1.857 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	7	14	7.0
Working	7	13	6.0
Capacity	7	14	7.0
Disconnected	0	0	0.0
Broken/Burned	0	1	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1932	209	2698	-37	4802
AVLCC \$	142	15	198	-3	353

System Number: 4      Descrip: 1x4 surface w/acrylic lens

Rooms Served: 2  
 Floor Area: 3788 SqFt  
 Possible kW: 0.576  
 Working kW: 0.576  
 Capacity kW: 0.576  
 Lighting: 1296 Annual kWh  
 Heating: 185 Annual kWh  
 Cooling: 1835 Annual kWh  
 Op Hours/Year: 2250 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 142.1 Months  
 Power Density: 0.152 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	12	6.0
Working	6	12	6.0
Capacity	6	12	6.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1656	179	2312	-32	4116
AVLCC \$	122	13	170	-2	303

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1520 - ECO VI/FSI D. & IX B., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$2,195	
B. SIOH	\$121	
C. DESIGN COST	\$132	
D. TOTAL COST (1A+1B+1C)	\$2,447	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$2,447

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	17.14	\$181	11.77	\$2,128
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	23.92	\$252	11.12	\$2,806
M. DEMAND SAVINGS			\$178	11.12	\$1,984
N. TOTAL		41.06	\$612		\$6,918

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$52	
1. DISCOUNT FACTOR (TABLE A)		11.1
2. DISCOUNTED SAVINGS/COST (3A X 3A1)		\$577

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

## **C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)**

\$577

## **4. SIMPLE PAYBACK $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :**

3.7 YEARS

## **5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):**

\$7,496

## **6. SAVINGS TO INVESTMENT RATIO (SIR) $5/1G$ :**

3.06

## **7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):**

12.1%



## **ENERGY CONSERVATION ANALYSIS**

### **BUILDING 1630 - YOUTH CENTER**

Building 1630 is a one story stucco recreational facility. This facility contains a small snack bar which consists of 480 square feet.

The operating hours for this facility are from 4:00 pm to 10:00 pm, Monday thru Friday and 7:00 am to 10:00 pm on Saturdays.

The lighting system is primarily fluorescent.

The mechanical system consists of multizone air handling units with DX cooling coils and an air cooled condensing units. Heating is provided by gas fired boiler.

Hot water is provided to the kitchen by a gas fired water heater.

The only recommended ECO's for this facility are as follows;

1. VII.D - Reduce Indoor/Outdoor Lighting to AEI Levels
2. IX.A - Replace Incandescent Lamps with Compact Fluorescents
3. IX.C - Replace Standard Lamps with Energy Saving Lamps
4. IX.D - Replace Standard Ballast with Energy Saving Ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO 1630

ECO NO: VII D & IX A, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>2,396.7</u>	KWH/yr
Demand Savings:	<u>5.47</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 133</u>	/yr
Implementation Cost:	<u>\$ 357</u>	
Simple Payback:	<u>2.7</u>	Years
Savings to Investment: Ratio (SIR):	<u>4.21</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current lighting levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
6	4-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
1	Bare incandescent	None.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= (1.252 \text{ KW} - .796 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (1.252 \text{ KW} - .796 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$36.48/\text{yr}\end{aligned}$$

**IMPLEMENTATION COSTS:**

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD1630A	1815	2627	5507	405	1040	8.219	1.278	320	286	4901	21	361
*BLD1630B	2855	0	8135	599	0	0.000	0.000	0	425	7709	31	567

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD1630A	POST RETROFIT CONDITIONS
BLD1630B	EXISTING CONDITIONS

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Whole Building Summary Report

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\8LD1630A.WBR

Date: 10/16/1993

Lighting Annual : 1815 kWh  
 Lighting Capacity : 0.796 kW  
 Annual Cooling Effect : 2367 kWh  
 Annual Heating Effect : 259 kWh  
 Total Surveyed Floor Area: 480 SqFt  
 Percent Survey Completed : 48000 %  
 Lighting Power Density : 1.658 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	320	2307	286	2638	-44	5507
AVLCC \$	24	170	21	194	-3	405

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\BLD1630A.LLR

Date: 10/16/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	50.5	7.1	30.7	21.97	3-entry	2-stor
Measured	51.5	2.7	23.4	25.23	1-kitchen	2-stor
Required	50.0	5.0	28.3	22.55	1-kitchen	2-stor

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	20.5	-15.4	2.4	17.98	3-entry	1-kitchen
Meas - Req.	1.5	-14.0	-4.9	8.10	1-kitchen	3-entry

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Lighting System Survey Summary

One Page for Each Defined System

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Subject: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\BLD1630A.LSR  
 Date: 10/16/1993

System Number: 1      Descrip: 4 lamp, 2x4 lay-in w/acrylic

=====

Rooms Served: 2  
 Floor Area: 400 SqFt  
 Possible kW: 0.696  
 Working kW: 0.696  
 Capacity kW: 0.696  
 Lighting: 1587 Annual kWh  
 Heating: 227 Annual kWh  
 Cooling: 2069 Annual kWh  
 Op Hours/Year: 2280 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 140.6 Months  
 Power Density: 1.740 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	24	6.0
Working	6	24	6.0
Capacity	6	24	6.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2018	168	2307	-39	4772
AVLCC \$	148	12	170	-3	351

System Number: 2      Descrip: bare incand.

=====

Rooms Served: 1  
 Floor Area: 80 SqFt  
 Possible kW: 0.100  
 Working kW: 0.100  
 Capacity kW: 0.100  
 Lighting: 228 Annual kWh  
 Heating: 33 Annual kWh  
 Cooling: 297 Annual kWh  
 Op Hours/Year: 2280 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 3.9 Months  
 Power Density: 1.250 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	290	118	331	-6	735
AVLCC \$	21	9	24	-0	54

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 | Room-By-Room Summary Report |  
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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\BLD1630A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total * Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM2 Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Watt Meas. FootC	Calc. Req. FootC
1-kitchen	1	1	*	320	2 4 lamp, 2x	464	464	1.45	464	464	1.45	464	464	1.45	464	51.5	34.6
2-stor	1	1		80	0 bare incan	100	100	1.25	100	100	1.25	100	100	1.25	100	2.7	7.1
3-entry	1	1		80	0 4 lamp, 2x	232	232	2.90	232	232	2.90	232	232	2.90	232	16.0	50.5

Total Rooms : 3  
 Total Area Sqft : 480  
 Total People : 2  
 Total Working kW : 0.796  
 Total Potential kW : 0.796  
 Power Density W/sqft : 1.658



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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\BLD1630B.WBR  
 Date: 10/16/1993

Lighting Annual : 2855 kWh  
 Lighting Capacity : 1.252 kW  
 Annual Cooling Effect : 3723 kWh  
 Annual Heating Effect : 408 kWh  
 Total Surveyed Floor Area: 480 Sqft  
 Percent Survey Completed : 48000 %  
 Lighting Power Density : 2.608 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	0	3629	425	4150	-70	8135
AVLCC \$	0	267	31	305	-5	599

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\1630\BLD1630B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 4 lamp, 2x4 lay-in w/acrylic

Rooms Served: 2  
Floor Area: 400 SqFt  
Possible kW: 1.152  
Working kW: 1.152  
Capacity kW: 1.152  
Lighting: 2627 Annual kWh  
Heating: 375 Annual kWh  
Cooling: 3425 Annual kWh  
Op Hours/Year: 2280 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 140.6 Months  
Power Density: 2.880 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	24	6.0
Working	6	24	6.0
Capacity	6	24	6.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3339	307	3818	-64	7401
AVLCC \$	246	23	281	-5	545

System Number: 2      Descrip: bare incand.

Rooms Served: 1  
Floor Area: 80 SqFt  
Possible kW: 0.100  
Working kW: 0.100  
Capacity kW: 0.100  
Lighting: 228 Annual kWh  
Heating: 33 Annual kWh  
Cooling: 297 Annual kWh  
Op Hours/Year: 2280 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 3.9 Months  
Power Density: 1.250 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	1	1	0.0
Working	1	1	0.0
Capacity	1	1	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	290	118	331	-6	734
AVLCC \$	21	9	24	-0	54

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 1630 - ECO VII D. & IX A., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$320	
B. SIOH	\$18	
C. DESIGN COST	\$19	
D. TOTAL COST (1A+1B+1C)	\$357	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$357

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	3.55	\$37	11.77	\$441
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	4.63	\$49	11.12	\$543
M. DEMAND SAVINGS			\$36	11.12	\$406
N. TOTAL		8.18	\$123		\$1,390

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$10	
1. DISCOUNT FACTOR (TABLE A)		11.1
2. DISCOUNTED SAVINGS/COST (3A X 3A1)		\$111

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

## **C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)**

\$111

## **4. SIMPLE PAYBACK $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :**

2.7 YEARS

## **5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):**

\$1,501

## **6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G:**

4.21

## **7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):**

14.5%

## ENERGY CONSERVATION ANALYSIS

### BUILDING 2265 - MESS HALL IN BARRACKS

Building 2265 is a three story barracks consisting of 106,000 square feet. This facility contains a large full service kitchen and dining area which consists of 4,100 square feet.

The operating hours for this facility are from 5:00 am to 8:00 pm, Monday to Friday and 7:00 am to 8:00 pm Saturday and Sunday.

The lighting system is primarily fluorescent.

The mechanical system consists of single zone air handling units served by a water cooled centrifugal chiller located in the basement. Heating is provided by gas fired boilers.

Hot water is provided to the kitchen by a gas fired water heater. Dishwashing is accomplished using an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 2265:

1. IV. D.1) - Replace chiller with higher EFF/CFC free chiller
2. VII. C. - Remove unneeded lamps or fixtures
3. VII. D. - Reduce indoor/outdoor lighting to AEI levels
4. IX. B. - Replace incandescent exit fixtures with LED
5. IX. C. - Replace standard lamps with energy saving lamps
6. IX. D. - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2265

ECO NO: IV. D 1)

ECO NAME: Replace chiller with higher efficiency CFC free chiller.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>424,595</u>	KWH/yr
Demand Savings:	<u>1,740</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 26,888</u>	/yr
Implementation Cost:	<u>\$ 338,516</u>	
Simple Payback:	<u>7.7</u>	Years
Savings to Investment: Ratio (SIR):	<u>2.02</u>	

#### ECO DESCRIPTION:

Currently, a 657 ton water cooled centrifugal chiller is in use. This chiller was installed in 1973 and operates at an efficiency of approximately .871 KW/ton. This ECO analyzes replacing this unit with a new high efficiency, CFC free chiller. The new chillers will operate with an efficiency of approximately .540 KW/ton (see following selection). This ECO analysis accounts for the interdependencies related to operating hours and the proposed lighting retrofit.

#### COST SAVINGS CALCULATIONS:

(Refer to following Trace Output)

$$\begin{aligned}\text{Demand Savings} &= (907 \text{ KW} - 792 \text{ KW}) \times 4 \text{ mo.} \times \$7.50/\text{KW} + (907 \text{ KW} - 792 \text{ KW}) \times 8 \text{ mo.} \times \$6.25/\text{KW} \\ &= \$9,200/\text{yr}\end{aligned}$$

**IMPLEMENTATION COSTS:**

(Refer to following Cost Estimate)

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

LINE # -----

1 JOB - 1  
2 01/FORT SAM HOUSTON EEAP  
3 01/SAN ANTONIO  
4 01/FWD-COE  
5 01/SCOTT CLARK  
6 01/HVAC IMPROVEMENTS  
7 08/SANANTON  
8 09/JAN/DEC  
9 10/CLTD-CLF  
10 11/JAN/DEC  
11 LOAD - 1  
12 19/1/ENERGY CONSERVATION SIMULATION  
13 20/1/1/FIRST FLOOR/500/185//4//14  
14 20/2/2/SECOND FLOOR/500/185//4//14  
15 20/3/3/THIRD FLOOR/500/185//4//14  
16 21/M/78/50/78//70/70  
17 22/3/1/YES///.07  
18 24/1/1/500/14/.15//0  
19 24/1/2/185/14/.15//90  
20 24/1/3/500/14/.15//180  
21 24/1/4/185/14/.15//270  
22 24/2/1/500/14/.15//0  
23 24/2/2/185/14/.15//90  
24 24/2/3/500/14/.15//180  
25 24/2/4/185/14/.15//270  
26 24/3/1/500/14/.15//0  
27 24/3/2/185/14/.15//90  
28 24/3/3/500/14/.15//180  
29 24/3/4/185/14/.15//270  
30 25/1/1//20/1.07/.7  
31 25/1/2//20/1.07/.7  
32 25/1/3//20/1.07/.7  
33 25/1/4//20/1.07/.7  
34 25/2/1//20/1.07/.7  
35 25/2/2//20/1.07/.7  
36 25/2/3//20/1.07/.7  
37 25/2/4//20/1.07/.7  
38 25/3/1//20/1.07/.7  
39 25/3/2//20/1.07/.7  
40 25/3/3//20/1.07/.7  
41 25/3/4//20/1.07/.7  
42 26/M/2265PLP/2265LT  
43 27/M/100/SF-PERS/255/255/2.0/WATT-SF///30  
44 28/M/1//1.5/WATT-SF/2265LT  
45 29/M/15/CFM-P/15/CFM-P  
46 30/M/.75/CFM-SF  
47 SYSTEM - 1  
48 39/1/EXISTING CONDITIONS  
49 40/1/VTCV  
50 41/1/1/3  
51 42/1/2.5  
52 43/1/54/62  
53 44/1/NONE  
54 45/1/AVAIL  
55 EQUIPMENT - 1  
56 60/1/1/PKPLANT/1/1  
57 61/1/1  
58 62/1/EQ1001L/1/657/TONS/.871/KW-TON



CONTENTS OF : H:\JOB\911099\12F\TRACE\EQUIPECO\2265.TM

LINE # -----

59 63/1/75/HP/35/HP  
60 64/1//NO/NO/NONE  
69/1/EQ4003  
62 70/1/100  
63 EQUIPMENT - 2  
64 60/1/1/PKPLANT/1/1  
65 61/1/1  
66 62/1/EQ1001L/1/657/TONS/.540/KW-TON  
67 63/1/75/HP/35/HP  
68 64/1//NO/NO/NONE  
69 69/1/EQ4003  
70 70/1/100

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TRACE 600 ANALYSIS  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 9:59:34 4/18/94  
Dataset Name: 2265 .TM

AIRFLOW - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	----- Main -----					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	41,625	208,125	208,125	208,125	41,625	0	0
Totals		41,625	208,125	208,125	208,125	41,625	0	0

CAPACITY - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

----- Cooling -----					----- Heating -----							
	Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating	
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
1	VTCV	562.6	0.0	0.0	562.6	-2,816,967	0	0	0	0	0	-2,816,967
Totals		562.6	0.0	0.0	562.6	-2,816,967	0	0	0	0	0	-2,816,967

The building peaked at hour 14 month 8 with a capacity of 562.6 tons

ENGINEERING CHECKS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	----- Cooling -----				----- Heating -----		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	20.00	0.75	369.9	493.2	24.33	0.75	-10.15	277,500

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						CLG SPACE PEAK *****			***** HEATING COIL PEAK *****			
Peak at Time ==> Mo/Hr: 8/14						*	Mo/Hr: 8/16			*	Mo/Hr: 13/ 1	
Outside Air ==> OADB/WB/HR: 96/ 79/126.0						*	OADB: 96			*	OADB: 30	
						*				*		
	Space	Ret. Air	Ret. Air	Net	Percnt	*	Space	Percnt	*	Space Peak	Coil Peak	Percnt
	Sens.+Lat.	Sensible	Latent	Total	Of Tot	*	Sensible	Of Tot	*	Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)
Envelope Loads						*			*			
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	335,369		335,369	4.97	*	0	0.00	*	0	-251,809	8.94
Glass Solar	375,928	0		375,928	5.57	*	410,452	11.39	*	0	0	0.00
Glass Cond	181,830	0		181,830	2.69	*	194,965	5.41	*	-540,565	-540,565	19.19
Wall Cond	148,848	77,994		226,842	3.36	*	167,787	4.66	*	-177,552	-273,453	9.71
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	0			0	0.00	*	0	0.00	*	0	0	0.00
Sub Total==>	706,606	413,363		1,119,969	16.59	*	773,203	21.46	*	-718,117	-1,065,827	37.84
Internal Loads						*			*			
Lights	427,486	183,208		610,695	9.05	*	446,448	12.39	*	0	0	0.00
People	724,136			724,136	10.73	*	363,247	10.08	*	0	0	0.00
Misc	1,245,446	0	0	1,245,446	18.45	*	1,273,860	35.36	*	0	0	0.00
Sub Total==>	2,397,069	183,208	0	2,580,278	38.22	*	2,083,555	57.84	*	0	0	0.00
Ceiling Load	167,550	-167,550		0	0.00	*	201,461	5.59	*	-97,656	0	0.00
Outside Air	0	0	0	2,222,663	32.92	*	0	0.00	*	0	-1,801,151	63.94
Sup. Fan Heat				370,000	5.48	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	544,082			544,082	8.06	*	544,082	15.10	*	0	0	0.00
Exhaust Heat		-85,804	0	-85,804	-1.27	*		0.00	*		50,011	-1.78
Minimal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
						*			*			
Grand Total==>	3,815,307	343,218	0	6,751,188	100.00	*	3,602,301	100.00	*	-815,774	-2,816,967	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
Total Capacity		Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	562.6	6,751.2	4,962.7	208,125	83.0	68.7	85.5	60.4	58.8	74.1	277,500	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Totals	562.6	6,751.2										
										Roof	92,500	0 0
										Wall	57,540	11,508 20

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA	20.0	Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent	41,625	41,625	Clg Cfm/Sqft	0.75	SADB	62.0	73.6
Main Htg	-2,817.0	208,125	61.1	73.6	Infil	0	0	Clg Cfm/Ton	369.93	Plenum	79.9	68.9
Aux Htg	0.0	0	0.0	0.0	Supply	208,125	208,125	Clg Sqft/Ton	493.25	Return	79.9	68.9
Preheat	-0.0	208,125	61.1	60.4	Mincfm	0	0	Clg Btuh/Sqft	24.33	Ret/OA	83.0	61.1
Reheat	0.0	0	0.0	0.0	Return	208,125	208,125	No. People	2,775	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	41,625	41,625	Htg % OA	20.0	Fn MtrTD	0.4	0.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	0.75	Fn BldTD	0.3	0.0
Total	-2,817.0				Auxil	0	0	Htg Btuh/Sqft	-10.15	Fn Frict	0.9	0.0

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC	DEMAND	WATER (1000 G1)
	On Peak (kWh)	On Peak (kW)	
Jan	247,328	610	160
Feb	204,913	579	119
March	295,463	659	262
April	337,897	695	368
May	389,877	735	506
June	392,642	763	568
July	420,851	802	664
Aug	426,188	841	685
Sept	397,514	814	586
Oct	323,823	713	346
Nov	289,579	672	256
Dec	243,931	630	151
Total	3,970,007	841	4,672

Building Energy Consumption = 48,828 (Btu/Sq Ft/Year)  
Source Energy Consumption = 146,497 (Btu/Sq Ft/Year)

Floor Area = 277,500 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref Num	Equip Code	Monthly Consumption												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	78171	70606	78171	75649	78171	75649	78171	78171	75649	78171	75649	78171	920,399
	PK	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L	2-STG CTV >555 TONS												
	ELEC	38537	29747	59569	81695	114938	126572	145912	151249	131443	74377	58049	36863	1,048,951
	PK	139.6	149.7	188.5	225.1	264.4	293.2	332.2	370.4	343.9	242.6	202.4	160.3	370.4
1	EQ5100	COOLING TOWER												
	ELEC	11741	276	25158	35709	40253	38955	40253	40253	38955	31867	27593	13440	344,454
	PK	54.1	14.3	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1
1	EQ5100	COOLING TOWER												
	WATER	160	119	262	368	506	568	664	685	586	346	256	151	4,672
	PK	0.7	0.8	1.0	1.2	1.3	1.5	1.6	1.8	1.7	1.3	1.1	0.8	1.8
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	30052	25056	39299	49216	55480	53691	55480	55480	53691	43922	38031	27740	527,137
	PK	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6
1	EQ5010	CONDENSER WATER PUMP C.V.												
	ELEC	14024	11693	18339	22968	25891	25056	25891	25891	25056	20497	17748	12945	245,997
	PK	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
	EQ5300	CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	ELEC	403	336	527	660	744	720	744	744	720	589	510	372	7,069
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	74400	67200	74400	72000	74400	72000	74400	74400	72000	74400	72000	74400	876,000
	PK	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value        840.5    (kW)  
Yearly Time of Peak 15 (hr)    8 (mo)

Hour 15    Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
----------------------	------------------------	-----------------------	---------------------------	-------------------------

Cooling Equipment

1	EQ1001L	2-STG CTV >555 TONS	534.9	63.64
---	---------	---------------------	-------	-------

Sub Total			534.9	63.64
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Sub Total			0.0	0.00
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Air Moving Equipment

1	SUMMATION OF FAN ELECTRICAL DEMAND		100.0	11.90
---	------------------------------------	--	-------	-------

Sub Total			100.0	11.90
-----------	--	--	-------	-------

Total			0.0	0.00
-------	--	--	-----	------

Miscellaneous

Lights	205.6	24.46
--------	-------	-------

Base Utilities	0.0	0.00
----------------	-----	------

Misc Equipment	0.0	0.00
----------------	-----	------

Sub Total	205.6	24.46
-----------	-------	-------

Grand Total	840.5	100.00
-------------	-------	--------



AIRFLOW - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- S Y S T E M S U M M A R Y -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply	Room Exhaust
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)	Airflow (Cfm)	Airflow (Cfm)
1	VTCV	41,625	208,125	208,125	208,125	41,625	0	0
Totals		41,625	208,125	208,125	208,125	41,625	0	0

CAPACITY - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- S Y S T E M S U M M A R Y -----  
(Design Capacity Quantities)

----- Cooling ----- Heating -----												
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)
1	VTCV	562.6	0.0	0.0	562.6	-2,816,967	0	0	0	0	0	-2,816,967
Totals		562.6	0.0	0.0	562.6	-2,816,967	0	0	0	0	0	-2,816,967

The building peaked at hour 14 month 8 with a capacity of 562.6 tons

ENGINEERING CHECKS - ALTERNATIVE 2  
ENERGY CONSERVATION SIMULATION

----- E N G I N E E R I N G C H E C K S -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	20.00	0.75	369.9	493.2	24.33	0.75	-10.15	277,500

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

***** COOLING COIL PEAK *****						***** CLG SPACE PEAK *****			***** HEATING COIL PEAK *****				
Peak at Time ==> Mo/Hr: 8/14						*	Mo/Hr: 8/16			*	Mo/Hr: 13/ 1		
Outside Air ==> OADB/WB/HR: 96/ 79/126.0						*	OADB: 96			*	OADB: 30		
						*				*			
	Space	Ret. Air	Ret. Air	Net	Percnt	*	Space	Percnt	*	Space Peak	Coil Peak	Percnt	
	Sens.+Lat.	Sensible	Latent	Total	Of Tot	*	Sensible	Of Tot	*	Space Sens	Tot Sens	Of Tot	
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)	*	(Btuh)	(%)	*	(Btuh)	(Btuh)	(%)	
Envelope Loads						*			*				
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00	
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00	
Roof Cond	0	335,369		335,369	4.97	*	0	0.00	*	0	-251,809	8.94	
Glass Solar	375,928	0		375,928	5.57	*	410,452	11.39	*	0	0	0.00	
Glass Cond	181,830	0		181,830	2.69	*	194,965	5.41	*	-540,565	-540,565	19.19	
Wall Cond	148,848	77,994		226,842	3.36	*	167,787	4.66	*	-177,552	-273,453	9.71	
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00	
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00	
Infiltration	0			0	0.00	*	0	0.00	*	0	0	0.00	
Sub Total==>	706,606	413,363		1,119,969	16.59	*	773,203	21.46	*	-718,117	-1,065,827	37.84	
Internal Loads						*			*				
Lights	427,486	183,208		610,695	9.05	*	446,448	12.39	*	0	0	0.00	
People	724,136			724,136	10.73	*	363,247	10.08	*	0	0	0.00	
Misc	1,245,446	0	0	1,245,446	18.45	*	1,273,860	35.36	*	0	0	0.00	
Sub Total==>	2,397,069	183,208	0	2,580,278	38.22	*	2,083,555	57.84	*	0	0	0.00	
Ceiling Load	167,550	-167,550		0	0.00	*	201,461	5.59	*	-97,656	0	0.00	
Outside Air	0	0	0	2,222,663	32.92	*	0	0.00	*	0	-1,801,151	63.94	
Sup. Fan Heat				370,000	5.48	*		0.00	*		0	0.00	
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00	
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00	
OV/UNDR Sizing	544,082			544,082	8.06	*	544,082	15.10	*	0	0	0.00	
Exhaust Heat		-85,804	0	-85,804	-1.27	*		0.00	*		50,011	-1.78	
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00	
						*			*				
Grand Total==>	3,815,307	343,218	0	6,751,188	100.00	*	3,602,301	100.00	*	-815,774	-2,816,967	100.00	

-----COOLING COIL SELECTION-----										-----AREAS-----			
	Total Capacity (Tons)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)	
				Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor			
Main Clg	562.6	6,751.2	4,962.7	208,125	83.0	68.7	85.5	60.4	58.8	74.1	277,500		
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0		
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0		
Totals	562.6	6,751.2											
										Roof	92,500	0	0
										Wall	57,540	11,508	20

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----					--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F	Type	Cooling	Heating	Clg % OA	Clg Cfm/Sqft	Clg Cfm/Ton	Clg Sqft/Ton	Clg Btuh/Sqft	No. People	Htg % OA	Type	Clg Htg
Main Htg	-2,817.0	208,125	61.1	73.6	Infil	41,625	41,625	0	0	0.75	369.93	2,775	20.0	SADB	62.0
Aux Htg	0.0	0	0.0	0.0	Supply	208,125	208,125	0	0	493.25	24.33			Plenum	79.9
Preheat	-0.0	208,125	61.1	60.4	Mincfm	0	0	0	0	24.33				Return	79.9
Reheat	0.0	0	0.0	0.0	Return	208,125	208,125	0	0	493.25	24.33			Ret/OA	83.0
Humidif	0.0	0	0.0	0.0	Exhaust	41,625	41,625	0	0	24.33				Runrnd	78.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	0	0	2,775				Fn MtrTD	0.4
Total	-2,817.0				Auxil	0	0	0	0	20.0				Fn BldTD	0.3
										0.75				Fn Frict	0.9
										-10.15					0.0

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TRACE 600 ANALYSIS \*\*  
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by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FMD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)  
  
Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20  
  
Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)  
  
Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)  
  
Time/Date Program was Run: 10: 5:53 4/18/94  
Dataset Name: 2265 .TM

MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC	DEMAND	WATER
	On Peak (kWh)	On Peak (kW)	
Jan	231,797	553	147
Feb	193,587	521	109
March	270,928	583	241
April	304,160	606	340
May	343,169	630	467
June	341,607	648	524
July	362,364	672	613
Aug	365,673	696	633
Sept	344,629	679	541
Oct	293,154	616	321
Nov	265,440	591	236
Dec	228,903	565	138
Total	3,545,412	696	4,309

Building Energy Consumption = 43,605 (Btu/Sq Ft/Year)  
Source Energy Consumption = 130,829 (Btu/Sq Ft/Year)

Floor Area = 277,500 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref Num	Equip Code	----- Monthly Consumption -----												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	78171	70606	78171	75649	78171	75649	78171	78171	75649	78171	75649	78171	920,399
	PK	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6	205.6
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001L	2-STG CTV >555 TONS												
	ELEC	23892	18442	36932	50652	71267	78476	90462	93771	81498	46112	35992	22854	650,352
	PK	86.6	92.8	116.9	139.6	163.9	181.8	206.0	229.7	213.2	150.4	125.5	99.4	229.7
1	EQ5100	COOLING TOWER												
	ELEC	10855	254	23260	33014	37216	36016	37216	37216	36016	29463	25511	12421	318,458
	PK	50.0	13.4	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
1	EQ5100	COOLING TOWER												
	WATER	147	109	241	340	467	524	613	633	541	321	236	138	4,309
	PK	0.6	0.7	1.0	1.1	1.2	1.4	1.5	1.7	1.6	1.2	1.0	0.8	1.7
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	30052	25056	39299	49216	55480	53691	55480	55480	53691	43922	38031	27740	527,137
	PK	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6
1	EQ5010	CONDENSER WATER PUMP C.V.												
	ELEC	14024	11693	18339	22968	25891	25056	25891	25891	25056	20497	17748	12945	245,997
	PK	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
EQ5300	CONTROL PANEL & INTERLOCK													

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

	ELEC	403	336	527	660	744	720	744	744	720	589	510	372	7,069
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	74400	67200	74400	72000	74400	72000	74400	74400	72000	74400	72000	74400	876,000
	PK	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 2

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value        695.7    (kW)  
Yearly Time of Peak 15 (hr)    8 (mo)

Hour 15    Month    8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Percnt Of Tot (%)
----------------------	------------------------	-----------------------	---------------------------	-------------------------

Cooling Equipment

1	EQ1001L	2-STG CTV >555 TONS	390.1	56.07
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Sub Total			390.1	56.07
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Sub Total			0.0	0.00
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Air Moving Equipment

1		SUMMATION OF FAN ELECTRICAL DEMAND	100.0	14.37
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Sub Total			100.0	14.37
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Total			0.0	0.00
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Miscellaneous

Lights			205.6	29.56
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Base Utilities			0.0	0.00
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Misc Equipment			0.0	0.00
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Sub Total			205.6	29.56
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Grand Total			695.7	100.00
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# CARTER & BURGESS COST ESTIMATING ANALYSIS

PROJECT NAME: FORT SAM HOUSTON EEAP

PROJECT NO: 91109912F

PROJECT LOCATION: SAN ANTONIO, TEXAS

ESTIMATOR: S.P. CLARK

<b>SUBMITTAL:</b>	<b>35.0%</b>
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DATE:	26-Oct-93
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ECO NO/ BUILDING: IV. D. 1) / BLDG 2265

CHECKED BY: DJY

[illegible]



BUILDING 2265 - CHILLER INFORMATION

Chrysler Airtemp Chiller

Model # C2MN 779-2

S/N 4C104272

4160V/3 $\phi$ /515 KW

Capacity: 657 tons

Efficiency = .784 KW/ton (new)

Derate Efficiency .05%/yr

Existing Efficiency = .871 KW/ton

TX 001/013

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# Texas Trane - Fort Worth Facsimile Cover Sheet

**To:** Scott Clark  
**Company:** Carter & Burgess  
**Phone:** 817-735-6038  
**Fax:** 817-735-6064

**From:** Arthur Murnan  
**Company:** Texas Trane  
**Phone:** 817-838-1301  
**Fax:** 817-831-8135

**Date:** October 11, 1993  
**Pages including this  
cover page:** 13

**Comments:**

Here is the information you requested. The Trane Centravac will  
cost about \$235,000.

*\$217,500.00 F&L 657 TON.*

PROJECT : HOSPITAL CHILLER REPLACEMENT  
LOCATION : FORT SAM HOUSTON - SAN ANTONIO  
BLDG. OWNER : U.S. ARMY  
PROGRAM USER : MURNAN  
COMMENTS : SCOTT CLARK - CARTER & BURGESS  
MACHINE : CVHF

TECU 28

TECU 28

\*\*\*\*\* INPUT CONDITIONS \*\*\*\*\*

DESIGN DUTY	710-657		
EXITING EVAP TEMP	44	ENTERING COND TEMP	85
EVAP FLOW RATE	2260	COND FLOW RATE	2830
EVAPORATOR PASSES	2	CONDENSER PASSES	2
MAX EVAP PRESSURE DROP	33	MAX COND PRESSURE DROP	24
FLUID TYPE	WATER	FLUID TYPE	WATER
FLUID %	0	FLUID %	0
VOLTAGE	4160		
FREQUENCY	60		
REFRIGERANT	123		

\*\*\*\*\* OUTPUT DATA \*\*\*\*\*  
NOTE - PERFORMANCE CERTIFIED IN ACCORDANCE WITH ARI STANDARD 550-92  
NOTE - EXTENDED SHELL SELECTION.

%LOAD		100%	75%	50%	25%
DESIGN DUTY	TONS	100%			
POWER CONSUMED	KW	710-657	533	355	178
KW PER DESIGN DUTY		383	256	171	100
APLV		0.539	0.481	0.482	0.563
		0.498			
EXIT EVAP TEMP	F	44.00			
EVAP FLOW RATE	GPM	2260.0	44.00	44.00	44.00
ENTERING EVAP TEMP	F	51.54			
EVAP PD (NON-MAR)	FEET	29.67			
EVAP PD (MARINE)	FEET	30.33			
EVAP FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
ENTERING COND TEMP	F	85.00	78.75	72.50	66.25
COND FLOW RATE	GPM	2830.0			
EXIT COND TEMP	F	91.97			
COND PD (NON-MAR)	FEET	20.60			
COND PD (MARINE)	FEET	21.64			
COND FOULING FACTOR		0.00025			
FLUID TYPE AND %		WATER 0			
MAX LRA AT MOTOR KW	AMPS	405			
RLA AT MOTOR KW	AMPS	62			
RLA AT SELECTION KW	AMPS	59			
REFRIGERANT CHARGE	LBS	1600			
SHIP WT. (W/NMAR WB.)	LBS	30721			
OPER WT. (W/NMAR WB.)	LBS	35397			

mod1-CVHF	nton-650	volt-4160	hrtz-60	type-SNGL	cpkw-403	cpim-275
evtm-TECU	evth-28	evsz-142M	evbs-980	evwp-2	orsz-880	refg-123
cdtm-TECU	cdth-28	cdsz-142S	cdb-1220	cdwp-2	cdty-STD	

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2265 - ECO IV. D. 1) - REPLACE CHILLER W/ HIGHER EFF/CFC FREE CHILLER  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$536,040	
B. SIOH	\$29,482	
C. DESIGN COST	\$32,162	
D. TOTAL COST (1A+1B+1C)	\$597,685	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$597,685

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	1449.1	\$15,288	14.65	\$223,969
B. DIST			\$0	17.70	\$0
C. RESID			\$0	20.99	\$0
D. NG	\$3.31	0.00	\$0	20.60	\$0
E. PPG			\$0	13.59	\$0
F. COAL			\$0	16.32	\$0
G. SOLAR			\$0	13.59	\$0
H. GEOTH			\$0	13.59	\$0
I. BIOMA			\$0	13.59	\$0
J. REFUS			\$0	13.59	\$0
K. WIND			\$0	13.59	\$0
L. OTHER			\$0	13.59	\$0
M. DEMAND SAVINGS			\$11,600	13.59	\$157,644
N. TOTAL		1449.1	\$26,888		\$381,613

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$0  
 1. DISCOUNT FACTOR (TABLE A) \_\_\_\_\_  
 2. DISCOUNTED SAVINGS/COST (3A X 3A1) \_\_\_\_\_ \$0

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. Chiller	\$338,516	3	0.89	\$301,279
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$338,516			\$301,279

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$301,279

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 13.6 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$682,893

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 1.14

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 4.7%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2265

ECO NO: VII C, D & IX B, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>49,856.4</u>	KWH/yr
Demand Savings:	<u>46.7</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 2,349</u>	/yr
Implementation Cost:	<u>\$ 2,723</u>	
Simple Payback:	<u>1.2</u>	Years
Savings to Investment: Ratio (SIR):	<u>9.77</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
2	2-Lamp, 2' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
58	2-Lamp, 4' Fluor.	Remove 16 fixtures along window area and retrofit remaining with T8 lamps and electronic ballasts.
12	4-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
4	Incand. Exit	Replace /LED exit fixtures.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= (8.065 \text{ KW} - 4.171 \text{ KW})(4 \text{ mo.} \times \$17.50/\text{KW} + 8 \text{ mo.} \times \$6.25/\text{KW}) \\ &= \$311.52/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cents/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD2265A	2354	49738	57821	4255	20874	20.372	-0.298	2442	3020	52360	222	3853
*BLD2265B	43228	0	107560	7914	0	0.000	0.000	0	6307	101253	464	7450

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD2265A	POST RETROFIT CONDITIONS
BLD2265B	EXISTING CONDITIONS



=====

| Whole Building Summary Report |

=====

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265A.WBR  
 Date: 10/17/1993

Lighting Annual : 22354 kWh  
 Lighting Capacity : 4.171 kW  
 Annual Cooling Effect : 31039 kWh  
 Annual Heating Effect : 3193 kWh  
 Total Surveyed Floor Area: 5320 SqFt  
 Percent Survey Completed : 532000 %  
 Lighting Power Density : 0.784 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2442	22107	3020	30801	-548	57821
AVLCC \$	180	1627	222	2266	-40	4255

=====

| Lighting Level Comparison Report |

=====

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265A.LLR  
 Date: 10/17/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	63.8	7.4	34.0	24.78	5-scullyery	4-dry stor
Measured	23.4	4.8	15.8	7.74	1-dining	3-stor
Required	50.0	5.0	25.0	23.18	2-kitchen	1-dining
Foot Candle						
Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	25.1	-7.6	9.0	12.00	1-dining	4-dry stor
Meas - Req.	18.4	-34.3	-9.2	21.46	1-dining	2-kitchen

=====

Lighting System Survey Summary

One Page for Each Defined System

=====

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265A.LSR  
 Date: 10/17/1993

System Number: 1      Descrip: 2 lamp, 2x2 lay-in w/crylic lens

=====

Rooms Served: 1  
 Floor Area: 3200 SqFt  
 Possible kW: 0.141  
 Working kW: 0.141  
 Capacity kW: 0.141  
 Lighting: 756 Annual kWh  
 Heating: 108 Annual kWh  
 Cooling: 1049 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 42.0 Months  
 Power Density: 0.044 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	747	121	1041	-19	1975
AVLCC \$	55	9	77	-1	145

System Number: 2      Descrip: 2x4 fluor. w/acrylic lens

=====

Rooms Served: 1  
 Floor Area: 3200 SqFt  
 Possible kW: 1.392  
 Working kW: 1.392  
 Capacity kW: 1.392  
 Lighting: 7461 Annual kWh  
 Heating: 1066 Annual kWh  
 Cooling: 10360 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 70.0 Months  
 Power Density: 0.435 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	12	48	12.0
Working	12	48	12.0
Capacity	12	48	12.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	7379	853	10280	-183	18965
AVLCC \$	543	63	756	-13	1395

System Number: 3      Descrip: 1x4 recess fluor.w/acrylic

Rooms Served: 3  
 Floor Area: 4588 SqFt  
 Possible kW: 2.386  
 Working kW: 2.386  
 Capacity kW: 2.386  
 Lighting: 12791 Annual kWh  
 Heating: 1827 Annual kWh  
 Cooling: 17760 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 70.0 Months  
 Power Density: 0.520 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	38	76	38.0
Working	38	76	38.0
Capacity	38	76	38.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	12650	1850	17624	-314	33369
AVLCC \$	931	136	1297	-23	2455

System Number: 4      Descrip: fluor. wrap

Rooms Served: 2  
 Floor Area: 732 SqFt  
 Possible kW: 0.251  
 Working kW: 0.251  
 Capacity kW: 0.251  
 Lighting: 1346 Annual kWh  
 Heating: 192 Annual kWh  
 Cooling: 1869 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 70.0 Months  
 Power Density: 0.343 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	8	4.0
Working	4	8	4.0
Capacity	4	8	4.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1332	195	1855	-33	3513
AVLCC \$	98	14	137	-2	258

Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265A.RRR  
 Date: 10/17/1993

Room Name	Floor	#	Total * Area	SYSTEM1 #Pr Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM2 Name	Work Watts	Pot. Watts	Watt sqft	SYSTEM3 Name	Work Watts	Pot. Watts	Watt sqft	Watt Meas. FootC	Calc. Req. FootC								
1-dining	1	1	*	3200	100	2x4	fluor.	1392	1392	0.44	1x4	recess	942	942	0.29	2 lamp, 2x	141	141	0.04	2475	2475	0.77	23.4	30.1	5.0
2-kitchen	1	1		812	6	1x4	recess	754	754	0.93				754	754	0.93	15.7	54.8		754	754	0.93	15.7	54.8	50.0
3-stor	1	1		84	0	fluor.	wra	63	63	0.75				63	63	0.75	4.8	13.7		63	63	0.75	4.8	13.7	5.0
4-dry stor	1	1		648	1	fluor.	wra	188	188	0.29				188	188	0.29	12.4	7.4		188	188	0.29	12.4	7.4	15.0
5-sculley	1	1		576	2	1x4	recess	691	691	1.20				691	691	1.20	22.8	63.8		691	691	1.20	22.8	63.8	50.0

Total Rooms : 5  
 Total Area Sqft : 5320  
 Total People : 109  
 Total Working kW : 4.171  
 Total Potential kW : 4.171  
 Power Density W/sqft : 0.784

=====

| Whole Building Summary Report |

=====

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265B.WBR  
 Date: 10/16/1993

Lighting Annual : 43228 kWh  
 Lighting Capacity : 8.065 kW  
 Annual Cooling Effect : 60022 kWh  
 Annual Heating Effect : 6175 kWh  
 Total Surveyed Floor Area: 5320 SqFt  
 Percent Survey Completed : 532000 %  
 Lighting Power Density : 1.516 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	0	42751	6307	59562	-1060	107560
AVLCC \$	0	3146	464	4383	-78	7914

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2265\BLD2265B.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 2 lamp, 2x2 lay-in w/crylic lens

Rooms Served: 1  
Floor Area: 3200 SqFt  
Possible kW: 0.193  
Working kW: 0.193  
Capacity kW: 0.193  
Lighting: 1034 Annual kWh  
Heating: 148 Annual kWh  
Cooling: 1436 Annual kWh  
Op Hours/Year: 5360 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 42.0 Months  
Power Density: 0.060 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	4	2.0
Working	2	4	2.0
Capacity	2	4	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1023	220	1425	-25	2643
AVLCC \$	75	16	105	-2	194

System Number: 3      Descrip: 2x4 fluor. w/acrylic lens

Rooms Served: 1  
Floor Area: 3200 SqFt  
Possible kW: 2.304  
Working kW: 2.160  
Capacity kW: 2.304  
Lighting: 12349 Annual kWh  
Heating: 1764 Annual kWh  
Cooling: 17147 Annual kWh  
Op Hours/Year: 5360 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 70.0 Months  
Power Density: 0.675 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	12	48	12.0
Working	12	45	11.0
Capacity	12	48	12.0
Disconnected	0	0	0.0
Broken/Burned	0	3	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	12213	1562	17016	-303	30488
AVLCC \$	899	115	1252	-22	2243

System Number: 4      Descrip: 1x4 recess fluor.w/acrylic

Rooms Served: 3  
 Floor Area: 4588 SqFt  
 Possible kW: 5.184  
 Working kW: 4.992  
 Capacity kW: 5.184  
 Lighting: 27786 Annual kWh  
 Heating: 3969 Annual kWh  
 Cooling: 38581 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 70.0 Months  
 Power Density: 1.088 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	54	108	54.0
Working	54	104	51.0
Capacity	54	108	54.0
Disconnected	0	0	0.0
Broken/Burned	0	4	1.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	27479	4213	38285	-681	69296
AVLCC \$	2022	310	2817	-50	5099

System Number: 6      Descrip: fluor. wrap

Rooms Served: 2  
 Floor Area: 732 SqFt  
 Possible kW: 0.384  
 Working kW: 0.384  
 Capacity kW: 0.384  
 Lighting: 2058 Annual kWh  
 Heating: 294 Annual kWh  
 Cooling: 2858 Annual kWh  
 Op Hours/Year: 5360 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 70.0 Months  
 Power Density: 0.525 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	4	8	4.0
Working	4	8	4.0
Capacity	4	8	4.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2035	312	2836	-50	5133
AVLCC \$	150	23	209	-4	378



# LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2265 - ECO VII C., D. & IX A., B., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

## 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$2,442				
B. SIOH	\$134				
C. DESIGN COST	\$147				
D. TOTAL COST (1A+1B+1C)	\$2,723				
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0			
F. PUBLIC UTILITY COMPANY REBATE		\$0			
G. TOTAL INVESTMENT (1D-1E-1F)				\$2,723	

## 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	71.24	\$752	11.77	\$8,846
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	98.92	\$1,044	11.12	\$11,605
M. DEMAND SAVINGS			\$312	11.12	\$3,469
N. TOTAL		170.16	\$2,107		\$23,920

## 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$242				
1. DISCOUNT FACTOR (TABLE A)		11.1			
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$2,686		

**LIFE CYCLE COST ANALYSIS SUMMARY**  
**ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$2,686

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 1.2 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$26,607

6. SAVINGS TO INVESTMENT RATIO (SIR) 5/1G: 9.77

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 21.1%

## ENERGY CONSERVATION ANALYSIS

### BUILDING 2399 - HOSPITAL MESS HALL

Building 2399 is a single story stucco building consisting of a total area of 26,000 square feet. This facility contains a full service kitchen and a large dining area which consists of 14,700 square feet.

The operating hours are from 5:00 am to 8:00 pm, seven days per week.

The lighting system is primarily fluorescent.

The mechanical system consists of fan coil units above the ceiling served by the central hospital water cooled chillers. Heating is provided by three central gas fired, steam boilers.

Hot water is provided to the kitchen by a steam to hot water heat exchanger and a 300 gallon storage tank. Dishwashing is accomplished using an automatic dishwasher with an electric hot water booster heater.

The following ECO's are recommended for Building 2399:

1. IV. A. - Night setback/setup thermostat
2. IV. D.1) - Replace chiller with higher EFF/CFC free chiller
3. IV. F. - Install make-up air supply for kitchen areas
4. VII. D. - Reduce indoor/outdoor lighting to AEI levels
5. IX. A. - Replace incandescent lamps with compact fluorescents
6. IX. B. - Replace incandescent exit fixtures with LED
7. IX. C. - Replace standard lamps with energy saving lamps
8. IX. D. - Replace standard ballast with energy saving ballast

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2399

ECO NO: IV. A.

ECO NAME: Night setback/setup thermostat.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>7,528</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>89.1</u>	MCF/yr
Cost Savings:	<u>\$ 575</u>	/yr
Implementation Cost:	<u>\$ 363</u>	
Simple Payback:	<u>.6</u>	Years
Savings to Investment: Ratio (SIR):	<u>21.61</u>	

#### ECO DESCRIPTION:

Currently, manual thermostats are used to control the existing fan coil units that serve the dining and office areas. Each fan coil unit is controlled by a separate thermostat. This ECO analyzes the installation of a programmable night setback/setup thermostats to reduce energy consumption during unoccupied periods.

#### COST SAVINGS CALCULATIONS:

(Refer to following SimpCalc)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### MAINTENANCE COSTS:

Maintenance costs of \$5.00/year is included in the LCCA for programming, battery replacement and failures.

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

TEXAS LoanSTAR Program - ECRM Simplified Calculation Ver 2.0

11/08/93

SimpCalc 2.0 SUMMARY (by FORM) - FORT SAM HOUSTON

Page 1

Form	Facility	ECRM Desc.	Page	KWH/Yr	KW	MCF/yr	mmBtu/Yr	\$/Yr	Imp.Cost	PayBack
C7-01	BLDG 2399 HOSPITAL DINING	Prog Thermostat	1	7528	.00	89.1	117.5	575	363	.6
*** SUB-TOTAL ***				7528	.00	89.1	117.5	575	363	.6
** GRAND TOTAL **				7528	.00	89.1	117.5	575	363	.6

11/08/93

Consolidated ECRM Detail - FORT SAM HOUSTON

Page 1

C7-001 Programmable Thermostats - BLDG 2399 HOSPITAL DINING

(G)

Cost Source: means cost data

Description: Install night setback/setup thermostats.

A) .15 BTU/hr-ft-F U-Value of Walls  
 B) 9072 Sq.Ft. Wall Area (includes windows and doors)  
 C) .07 BTU/hr-ft-F U-Value of Roof  
 D) 25922 Sq.Ft. Roof Area  
 E) 70 Degree/F Heating Season Thermostat Setpoint  
 F) 55 Degree/F Heating Season Thermostat Setback Setpoint  
 G) 1350 Hours/yr Heating Season Setback Hours  
     = 9 Hrs/day x 150 Days/yr  
 H) 74 Degree/F Cooling Season Thermostat Setpoint  
 I) 90 Degree/F Cooling Season Thermostat Setback Setpoint  
 J) 1800 Hours/yr Cooling Season Setback Hours  
     = 9 Hrs/day x 200 Days/yr  
 K) .7000 Heating Equipment Efficiency (Table 2)  
 L) \$ 3.41 /MCF Cost per MCF  
 M) 12.12 BTUH/Watt EER of Air Conditioning Unit (Table 1)  
 N) \$ .0360 /KWH Cost per KWH - Summer  
 O) \$ 363 Installed Cost = 3 Thermostats x \$ 121/stat  
  
 P) 3175 BTU/hf-F Total Envelope UA-Value  
 Q) 64.3 mmBTU/yr Heating Load Reduction  
 R) \$ 304 Heating Cost Reduction  
 S) 91.4 mmBTU/yr Cooling Load Reduction  
 T) \$ 271 /year Cooling Cost Reduction  
 U) \$ 575 /year Annual Cost Savings  
 V) .6 years Simple Payback

PROJECT NAME: FORT SAM HOUSTON EEAP	PROJECT NO: 91109912F
PROJECT LOCATION: SAN ANTONIO, TEXAS	ESTIMATOR: S.P. CLARK
SUBMITTAL: 35.0%	DATE: 26-Oct-93
ECO NO/ BUILDING: IV. A. / BLDG 2399	CHECKED BY: DJY

**26-Oct-93**



# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2399 - ECO IV. A. - NIGHT SETBACK/SETUP THERMOSTAT  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$326		
B. SIOH	\$18		
C. DESIGN COST	\$20		
D. TOTAL COST (1A+1B+1C)	\$363		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$363

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: 'NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	25.69	\$271	11.77	\$3,190
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	91.86	\$304	15.34	\$4,664
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. OTHER			\$0	11.12	\$0
M. DEMAND SAVINGS			\$0	11.12	\$0
N. TOTAL		117.55	\$575		\$7,854

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)		(\$15)	
1. DISCOUNT FACTOR (TABLE A)			11.1
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			(\$167)

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** (\$167)

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 0.6 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$7,688

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 21.15

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 27.5%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's)- BUILDING 2399

ECO NO: IV.D.1)

ECO NAME: Replace chiller with higher efficiency, CFC free chiller.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>926.098</u>	KWH/yr
Demand Savings:	<u>3.192</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 54,626</u>	/yr
Implementation Cost:	<u>\$ 365,824</u>	
Simple Payback:	<u>5.1</u>	Years
Savings to Investment: Ratio (SIR):	<u>3.02</u>	

#### ECO DESCRIPTION:

Currently, two 436 ton water cooled centrifugal chillers are in use. These chillers serve Building 2399 and 2376 (hospital) and were installed in 1968. These chillers operate at an efficiency of 1.084 KW/ton and have 80% demand limiting setpoints. This ECO analyzes replacement of the two, 436 ton chillers with one 710 ton high efficiency, CFC free chiller. This would allow one of the 436 ton chillers to remain as back-up and the refrigerant from the demolition chiller could be recovered for future use. The new chiller will operate at an efficiency of approximately .539 KW/ton. This ECO analysis accounts for the operating hours and for the proposed lighting retrofit.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned} \text{Demand Savings} &= (1,939 \text{ KW} - 1,842 \text{ KW})(4 \text{ mo.} \times \$7.50/\text{KW} + 8 \text{ mo.} \times \$6.25/\text{KW}) \\ &= \$7,760/\text{yr} \end{aligned}$$

**IMPLEMENTATION COSTS:**

(Refer to following Cost Estimate)

**LIFE CYCLE COST ANALYSIS:**

(Refer to following ECIP Life Cycle Cost Summary)

LINE #	
1	JOB - 1
2	01/FORT SAM HOUSTON EEAP
3	01/SAN ANTONIO
4	01/FWD-COE
5	01/SCOTT CLARK
6	01/HVAC IMPROVEMENTS
7	08/SANANTON
8	09/JAN/DEC
9	10/CLTD-CLF
10	11/JAN/DEC
11	LOAD - 1
12	19/1/ENERGY CONSERVATION SIMULATION
13	20/1/1/FIRST FLOOR/600/200//4//14
14	20/2/2/FIRST FLOOR/600/200//4//14
15	20/3/3/FIRST FLOOR/600/200//4//14
16	21/M/78/50/78//70/70
17	22/3/1/YES///.07
18	24/1/1/200/14/.15
19	24/1/2/600/14/.15//90
20	24/1/3/200/14/.15//180
21	24/1/4/600/14/.15//270
22	24/2/1/200/14/.15
23	24/2/2/600/14/.15//90
24	24/2/3/200/14/.15//180
25	24/2/4/600/14/.15//270
26	24/3/1/200/14/.15
27	24/3/2/600/14/.15//90
28	24/3/3/200/14/.15//180
29	24/3/4/600/14/.15//270
30	25/1/1///15/1.07/.7
31	25/1/2///15/1.07/.7
32	25/1/3///15/1.07/.7
33	25/1/4///15/1.07/.7
34	25/2/1///15/1.07/.7
35	25/2/2///15/1.07/.7
36	25/2/3///15/1.07/.7
37	25/2/4///15/1.07/.7
38	25/3/1///15/1.07/.7
39	25/3/2///15/1.07/.7
40	25/3/3///15/1.07/.7
41	25/3/4///15/1.07/.7
42	26/M/2399PLP/2399LT
43	27/M/150/SF-PERS/255/255/2.5/WATT-SF///30
44	28/M/1//1.0/WATT-SF/2399LT
45	29/M/15/CFM-P/15/CFM-P
46	30/M/.75/CFM-SF
47	SYSTEM - 1
48	39/1/EXISTING EQUIPMENT
49	40/1/VTCV
50	41/1/1/3
51	42/1/2.5
52	43/1/54/62
53	44/1/NONE
54	45/1/AVAIL
55	EQUIPMENT - 1
56	60/1/1/PKPLANT/1/1
57	61/1/1
58	62/1/EQ1001S/2/436/TONS/1.084/KW-TON/////SER

CONTENTS OF : H:\JOB\911099\12F\TRACE\EQUIPECO\2399.TM

LINE # -----

59 63/1/142/HP/50/HP  
60 64/1//NO/NO/NONE  
69/1/EQ4003  
62 70/1/380  
63 EQUIPMENT - 2  
64 60/1/1/PKPLANT/1/1  
65 61/1/1  
66 62/1/EQ1001S/1/710/TONS/.539/KW-TON  
67 63/1/142/HP/50/HP  
68 64/1//NO/NO/NONE  
69 69/1/EQ4003  
70 70/1/380

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\*\*\*\*\*  
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\*\* TRACE 600 ANALYSIS \*\*  
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\*\* by \*\*  
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\*\*\*\*\*

FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 16:39: 0 4/17/94  
Dataset Name: 2399 .TM

AIRFLOW - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Main					Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
		Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)		
1	VTCV	36,000	270,000	270,000	270,000	36,000	0	0
Totals		36,000	270,000	270,000	270,000	36,000	0	0

CAPACITY - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

		Cooling					Heating						
		Main Sys.	Aux. Sys.	Opt. Vent	Cooling	Main Sys.	Aux. Sys.	Preheat	Reheat	Humidif.	Opt. Vent	Heating	
System	System	Capacity	Capacity	Capacity	Totals	Capacity	Capacity	Capacity	Capacity	Capacity	Capacity	Totals	
Number	Type	(Tons)	(Tons)	(Tons)	(Tons)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(Btuh)	
1	VTCV	670.9	0.0	0.0	670.9	-2,655,673	0	0	0	0	0	-2,655,673	
Totals		670.9	0.0	0.0	670.9	-2,655,673	0	0	0	0	0	-2,655,673	

The building peaked at hour 15 month 8 with a capacity of 664.0 tons

ENGINEERING CHECKS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- ENGINEERING CHECKS -----

System Number	Main/ Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area Sq Ft
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	
1	Main	VTCV	13.33	0.75	402.5	536.6	22.36	0.75	-7.38	360,000



System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 7/16 \* Mo/Hr: 13/ 1  
Outside Air ==> OADB/WB/HR: 96/ 79/126.0 \* OADB: 96 \* OADB: 30

	Space	Ret. Air	Ret. Air	Net	Percnt		Space	Percnt		Space Peak	Coil Peak	Percnt
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads												
Skylite Solr	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Skylite Cond	0	0		0	0.00	*	0	0.00	*	0	0	0.00
Roof Cond	0	512,805		512,805	6.37	*	0	0.00	*	0	-326,920	12.31
Glass Solar	386,400	0		386,400	4.80	*	467,040	9.99	*	0	0	0.00
Glass Cond	162,863	0		162,863	2.02	*	173,648	3.72	*	-473,488	-473,488	17.83
Wall Cond	197,374	92,875		290,248	3.61	*	232,450	4.97	*	-227,520	-339,607	12.79
Partition	0			0	0.00	*	0	0.00	*	0	0	0.00
Exposed Floor	0			0	0.00	*	0	0.00	*	0	0	0.00
Infiltration	0			0	0.00	*	0	0.00	*	0	0	0.00
Sub Total==>	746,636	605,679		1,352,315	16.80	*	873,138	18.68	*	-701,008	-1,140,015	42.93
Internal Loads												
Lights	910,304	390,130		1,300,435	16.15	*	935,591	20.02	*	0	0	0.00
People	1,195,440			1,195,440	14.85	*	591,600	12.66	*	0	0	0.00
Misc	1,085,334	0	0	1,085,334	13.48	*	1,105,812	23.66	*	0	0	0.00
Sub Total==>	3,191,079	390,130	0	3,581,209	44.48	*	2,633,003	56.34	*	0	0	0.00
Ceiling Load	279,678	-279,678		0	0.00	*	309,070	6.61	*	-123,298	0	0.00
Outside Air	0	0	0	1,874,371	23.28	*	0	0.00	*	0	-1,557,752	58.66
Sup. Fan Heat				480,000	5.96	*		0.00	*		0	0.00
Ret. Fan Heat		0		0	0.00	*		0.00	*		0	0.00
Duct Heat Pkup		0		0	0.00	*		0.00	*		0	0.00
OV/UNDR Sizing	858,046			858,046	10.66	*	858,046	18.36	*	0	0	0.00
Exhaust Heat		-95,484	0	-95,484	-1.19	*		0.00	*		42,095	-1.59
Terminal Bypass		0	0	0	0.00	*		0.00	*		0	0.00
Grand Total==>	5,075,438	620,648	0	8,050,457	100.00	*	4,673,256	100.00	*	-824,306	-2,655,673	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	670.9	8,050.5	6,253.4	270,000	82.5	67.8	81.7	60.4	58.6	73.3	360,000	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0	0	
Totals	670.9	8,050.5								Roof	120,000	0 0
										Wall	67,200	10,080 15

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--		--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA		Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent	36,000	36,000	Clg Cfm/Sqft	13.3	SADB	62.0	72.8
Main Htg	-2,655.7	270,000	63.7	72.8	Infil	0	0	Clg Cfm/Ton	0.75	Plenum	80.5	68.9
Aux Htg	0.0	0	0.0	0.0	Supply	270,000	270,000	Clg Sqft/Ton	402.46	Return	80.5	68.9
Preheat	-0.0	270,000	63.7	60.4	Minclm	0	0	Clg Btuh/Sqft	536.62	Ret/OA	82.5	63.7
Reheat	0.0	0	0.0	0.0	Return	270,000	270,000	No. People	22.36	Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	36,000	36,000	Htg % OA	2,400	Fn MtrTD	0.4	0.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/Sqft	13.3	Fn BldTD	0.3	0.0
Total	-2,655.7				Auxil	0	0	Htg Btuh/Sqft	0.75	Fn Frict	0.9	0.0
									-7.38			

ZONE PSYCHROMETRICS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- PSYCHROMETRIC STATE POINTS -----

Zone 1

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.2	50.9	75.4	30.5	
Main System						
Return Air Heat Pickup						2.7
Return Fan						0.0
Return Air	80.7	66.0	46.6	75.4	31.2	
Outdoor Air	95.5	78.6	48.2	126.0	42.8	
Return/Outdoor Air Mix	82.7	67.9	47.5	82.1	32.7	
Blow through Fan						0.0
Entering Coil	82.7	67.9	47.5	82.1	32.7	
Leaving Coil	60.4	58.4	89.6	72.5	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.5	72.5	26.2	
Supply Air	62.0	59.0	84.5	72.5	26.2	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

ZONE PSYCHROMETRICS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- PSYCHROMETRIC STATE POINTS -----

Zone 2

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.2	50.9	75.4	30.5	
Main System						
Return Air Heat Pickup						2.7
Return Fan						0.0
Return Air	80.7	66.0	46.6	75.4	31.2	
Outdoor Air	95.5	78.6	48.2	126.0	42.8	
Return/Outdoor Air Mix	82.7	67.9	47.5	82.1	32.7	
Blow through Fan						0.0
Entering Coil	82.7	67.9	47.5	82.1	32.7	
Leaving Coil	60.4	58.4	89.6	72.5	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.5	72.5	26.2	
Supply Air	62.0	59.0	84.5	72.5	26.2	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

ZONE PSYCHROMETRICS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- PSYCHROMETRIC STATE POINTS -----

Zone 3

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.1	50.7	75.1	30.5	
Main System						
Return Air Heat Pickup						2.7
Return Fan						0.0
Return Air	80.7	66.0	46.4	75.1	31.1	
Outdoor Air	96.1	77.8	44.8	119.0	41.8	
Return/Outdoor Air Mix	82.8	67.7	46.7	80.9	32.6	
Blow through Fan						0.0
Entering Coil	82.8	67.7	46.7	80.9	32.6	
Leaving Coil	60.4	58.4	89.2	72.2	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.2	72.2	26.1	
Supply Air	62.0	59.0	84.2	72.2	26.1	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

BUILDING U-VALUES - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- B U I L D I N G U - V A L U E S -----

		----- Room U-Values ----- (Btu/hr/sqft/F)										Room	Room
Room				Summr	Wintr		Summr	Wintr			Mass	Capac.	
Number	Description	Part.	ExFlr	Skylt	Skylt	Roof	Windo	Windo	Wall	Ceil.	(lb/ sqft)	(Btu/ sqft/F)	
1	FIRST FLOOR	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17	
Zone	1 Total/Ave.	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17	
2	FIRST FLOOR	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17	
Zone	2 Total/Ave.	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17	
3	FIRST FLOOR	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	33.7	7.63	
Zone	3 Total/Ave.	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	33.7	7.63	
System	1 Total/Ave.	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	21.8	4.66	
Building		0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	21.8	4.66	

BUILDING AREAS - ALTERNATIVE 1  
ENERGY CONSERVATION SIMULATION

----- B U I L D I N G A R E A S -----

Room Number	Description	Number of Duplicate		Floor Area/Dupl Room	Total Floor Area	Partition Area	Exposed Floor Area	Skylight Area	Skl /Rf	Net Roof Area	Window Area	Win /Wl	Net Wall Area
		Flr	Rm	(sqft)	(sqft)	(sqft)	(sqft)	(sqft)	(%)	(sqft)	(sqft)	(%)	(sqft)
Zone 1	1 FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	0	3,360	15	19,040
	1 Total/Ave.				120,000	0	0	0	0	0	3,360	15	19,040
Zone 2	2 FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	0	3,360	15	19,040
	2 Total/Ave.				120,000	0	0	0	0	0	3,360	15	19,040
Zone 3	3 FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	120,000	3,360	15	19,040
	3 Total/Ave.				120,000	0	0	0	0	120,000	3,360	15	19,040
System	1 Total/Ave.				360,000	0	0	0	0	120,000	10,080	15	57,120
Building					360,000	0	0	0	0	120,000	10,080	15	57,120

## MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 1

## ----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC	DEMAND	WATER
	On Peak (kWh)	On Peak (kW)	
Jan	611,326	1,244	261
Feb	544,477	1,254	216
March	689,033	1,345	395
April	726,229	1,412	518
May	783,372	1,478	661
June	778,064	1,496	719
July	826,273	1,510	823
Aug	832,672	1,515	839
Sept	783,472	1,504	727
Oct	718,949	1,432	477
Nov	661,178	1,356	371
Dec	619,548	1,277	253
Total	8,574,594	1,515	6,261

Building Energy Consumption = 81,292 (Btu/Sq Ft/Year)  
Source Energy Consumption = 243,900 (Btu/Sq Ft/Year)

Floor Area = 360,000 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref	Equip Num Code	Monthly Consumption												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	169442	153045	169442	163976	169442	163976	169442	169442	163976	169442	163976	169442	1,995,047
	PK	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9	430.9
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CTV <555 TONS												
	ELEC	60832	51559	90566	123379	160427	175213	203328	209727	180621	110235	85873	60344	1,512,104
	PK	204.0	224.7	305.0	371.4	437.7	455.5	469.5	474.3	463.2	391.1	315.6	236.4	474.3
1	EQ5100	COOLING TOWER												
	ELEC	9098	3915	21378	27107	28010	27106	28010	28010	27107	25676	22589	11860	259,866
	PK	37.6	26.5	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6	37.6
1	EQ5100	COOLING TOWER												
	WATER	261	216	395	518	661	719	823	839	727	477	371	253	6,261
	PK	1.0	1.1	1.4	1.6	1.8	1.8	1.8	1.8	1.8	1.7	1.4	1.1	1.8
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	65652	59298	91912	101654	105042	101654	105042	105042	101654	96289	84712	70028	1,087,980
	PK	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2
1	EQ5010	CONDENSER WATER PUMP C.V.												
	ELEC	23117	20880	32363	35794	36987	35794	36987	36987	35794	33905	29828	24658	383,092
	PK	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
	EQ5300	CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1

	ELEC	465	420	651	720	744	720	744	744	720	682	600	496	7,706
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	282720	255360	282720	273600	282720	273600	282720	282720	273600	282720	273600	282720	3,328,800
	PK	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0



UTILITY PEAK CHECKSUMS - ALTERNATIVE 1

----- UTILITY PEAK CHECKSUMS -----

Utility ELECTRIC DEMAND

Peak Value 1,514.8 (kW)  
Yearly Time of Peak 12 (hr) 8 (mo)

Hour 12 Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
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Cooling Equipment

1	EQ1001S	2-STG CTV <555 TONS	703.9	46.47
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Sub Total			703.9	46.47
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Sub Total			0.0	0.00
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Air Moving Equipment

1		SUMMATION OF FAN ELECTRICAL DEMAND	380.0	25.09
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Sub Total			380.0	25.09
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Total			0.0	0.00
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Miscellaneous

Lights			430.9	28.45
Base Utilities			0.0	0.00
Misc Equipment			0.0	0.00
Sub Total			430.9	28.45

Grand Total			1,514.8	100.00
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\*\* TRACE 600 ANALYSIS \*\*  
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\*\* by \*\*  
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FORT SAM HOUSTON EEAP  
SAN ANTONIO  
FWD-COE  
SCOTT CLARK  
HVAC IMPROVEMENTS

Weather File Code: SANANTON  
Location: FORT SAM HOUSTON  
Latitude: 29.0 (deg)  
Longitude: 98.0 (deg)  
Time Zone: 6  
Elevation: 792 (ft)  
Barometric Pressure: 29.0 (in. Hg)

Summer Clearness Number: 0.90  
Winter Clearness Number: 0.90  
Summer Design Dry Bulb: 97 (F)  
Summer Design Wet Bulb: 76 (F)  
Winter Design Dry Bulb: 30 (F)  
Summer Ground Relectance: 0.20  
Winter Ground Relectance: 0.20

Air Density: 0.0738 (Lbm/cuft)  
Air Specific Heat: 0.2444 (Btu/lbm/F)  
Density-Specific Heat Prod: 1.0818 (Btu-min./hr/cuft/F)  
Latent Heat Factor: 4,761.9 (Btu-min./hr/cuft)  
Enthalpy Factor: 4.4255 (Lb-min./hr/cuft)

Design Simulation Period: January To December  
System Simulation Period: January To December  
Cooling Load Methodology: CLTD/CLF (Transfer Function Method)

Time/Date Program was Run: 12: 3:14 4/18/94  
Dataset Name: 2399 .TM

AIRFLOW - ALTERNATIVE 2  
NEW CHILLER

----- SYSTEM SUMMARY -----  
(Design Airflow Quantities)

System Number	System Type	Outside Airflow (Cfm)	Cooling Airflow (Cfm)	Main Heating Airflow (Cfm)	Return Airflow (Cfm)	Exhaust Airflow (Cfm)	Auxil. Supply Airflow (Cfm)	Room Exhaust Airflow (Cfm)
1	VTCV	36,000	270,000	270,000	270,000	36,000	0	0
Totals		36,000	270,000	270,000	270,000	36,000	0	0

CAPACITY - ALTERNATIVE 2  
NEW CHILLER

----- SYSTEM SUMMARY -----  
(Design Capacity Quantities)

System Number	System Type	Cooling					Heating						
		Main Sys. Capacity (Tons)	Aux. Sys. Capacity (Tons)	Sys. Opt. Capacity (Tons)	Vent Capacity (Tons)	Cooling Totals (Tons)	Main Sys. Capacity (Btuh)	Aux. Sys. Capacity (Btuh)	Preheat Capacity (Btuh)	Reheat Capacity (Btuh)	Humidif. Capacity (Btuh)	Opt. Vent Capacity (Btuh)	Heating Totals (Btuh)
1	VTCV	668.5	0.0	0.0	0.0	668.5	-2,655,673	0	0	0	0	0	-2,655,673
Totals		668.5	0.0	0.0	0.0	668.5	-2,655,673	0	0	0	0	0	-2,655,673

The building peaked at hour 15 month 8 with a capacity of 661.7 tons

ENGINEERING CHECKS - ALTERNATIVE 2  
NEW CHILLER

----- ENGINEERING CHECKS -----

System Number	Main/Auxiliary	System Type	Percent Outside Air	Cooling				Heating		Floor Area
				Cfm/ Sq Ft	Cfm/ Ton	Sq Ft /Ton	Btuh/ Sq Ft	Cfm/ Sq Ft	Btuh/ Sq Ft	Sq Ft
1	Main	VTCV	13.33	0.75	403.9	538.5	22.28	0.75	-7.38	360,000

System 1 Peak VTCV - VARIABLE TEMP CONSTANT VOL

\*\*\*\*\* COOLING COIL PEAK \*\*\*\*\* CLG SPACE PEAK \*\*\*\*\* HEATING COIL PEAK \*\*\*\*\*  
Peaked at Time ==> Mo/Hr: 8/14 \* Mo/Hr: 7/16 \* Mo/Hr: 13/ 1  
Outside Air ==> OADB/WB/HR: 96/ 79/126.0 \* OADB: 96 \* OADB: 30

	Space	Ret. Air	Ret. Air	Net	Percnt		Space	Percnt		Space Peak	Coil Peak	Percnt
	Sens.+Lat.	Sensible	Latent	Total	Of Tot		Sensible	Of Tot		Space Sens	Tot Sens	Of Tot
	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%)		(Btuh)	(%)		(Btuh)	(Btuh)	(%)
Envelope Loads												
Skylite Solr	0	0		0	0.00		0	0.00		0	0	0.00
Skylite Cond	0	0		0	0.00		0	0.00		0	0	0.00
Roof Cond	0	513,864		513,864	6.41		0	0.00		0	-326,920	12.31
Glass Solar	386,400	0		386,400	4.82		467,040	9.99		0	0	0.00
Glass Cond	162,863	0		162,863	2.03		173,648	3.72		-473,488	-473,488	17.83
Wall Cond	197,374	93,238		290,611	3.62		232,450	4.97		-227,520	-339,607	12.79
Partition	0			0	0.00		0	0.00		0	0	0.00
Exposed Floor	0			0	0.00		0	0.00		0	0	0.00
Infiltration	0			0	0.00		0	0.00		0	0	0.00
Sub Total==>	746,636	607,102		1,353,738	16.87		873,138	18.68		-701,008	-1,140,015	42.93
Internal Loads												
Lights	787,486	337,494		1,124,980	14.02		809,360	17.32		0	0	0.00
People	1,195,440			1,195,440	14.90		591,600	12.66		0	0	0.00
Misc	1,085,334	0	0	1,085,334	13.53		1,105,812	23.66		0	0	0.00
Sub Total==>	3,068,259	337,494	0	3,405,753	42.45		2,506,772	53.64		0	0	0.00
Ceiling Load	265,294	-265,294		0	0.00		294,286	6.30		-123,298	0	0.00
Outside Air	0	0	0	1,874,371	23.36		0	0.00		0	-1,557,752	58.66
Sup. Fan Heat				480,000	5.98			0.00			0	0.00
Ret. Fan Heat		0		0	0.00			0.00			0	0.00
Duct Heat Pkup		0		0	0.00			0.00			0	0.00
OV/UNDR Sizing	999,060			999,060	12.45		999,060	21.38		0	0	0.00
Heat Heat		-90,573	0	-90,573	-1.13			0.00			42,095	-1.59
Terminal Bypass		0	0	0	0.00			0.00			0	0.00
Grand Total==>	5,079,249	588,728	0	8,022,349	100.00		4,673,256	100.00		-824,306	-2,655,673	100.00

-----COOLING COIL SELECTION-----										-----AREAS-----		
	Total Capacity	Sens Cap.	Coil Airfl	Entering DB/WB/HR			Leaving DB/WB/HR			Gross Total	Glass (sf)	(%)
	(Tons)	(Mbh)	(cfm)	Deg F	Deg F	Grains	Deg F	Deg F	Grains	Floor		
Main Clg	668.5	8,022.3	6,225.3	270,000	82.4	67.8	81.7	60.4	58.6	73.3	360,000	
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	
Totals	668.5	8,022.3										
										Part	0	
										ExFlr	0	
										Roof	120,000	0 0
										Wall	67,200	10,080 15

-----HEATING COIL SELECTION-----					-----AIRFLOWS (cfm)-----			--ENGINEERING CHECKS--			--TEMPERATURES (F)---		
	Capacity	Coil Airfl	Ent	Lvg	Type	Cooling	Heating	Clg % OA			Type	Clg	Htg
	(Mbh)	(cfm)	Deg F	Deg F	Vent	36,000	36,000	Clg Cfm/Sqft	13.3		SADB	62.0	72.8
Main Htg	-2,655.7	270,000	63.7	72.8	Infil	0	0	Clg Cfm/Ton	0.75		Plenum	80.3	68.9
Aux Htg	0.0	0	0.0	0.0	Supply	270,000	270,000	Clg Sqft/Ton	403.87		Return	80.3	68.9
Preheat	-0.0	270,000	63.7	60.4	Mincfm	0	0	Clg Btuh/Sqft	538.50		Ret/OA	82.4	63.7
Reheat	0.0	0	0.0	0.0	Return	270,000	270,000	No. People	22.28		Runarnd	78.0	70.0
Humidif	0.0	0	0.0	0.0	Exhaust	36,000	36,000	Htg % OA	2,400		Fn MtrTD	0.4	0.0
Opt Vent	0.0	0	0.0	0.0	Rm Exh	0	0	Htg Cfm/SqFt	13.3		Fn BldTD	0.3	0.0
Total	-2,655.7				Auxil	0	0	Htg Btuh/SqFt	0.75		Fn Frict	0.9	0.0
									-7.38				

ZONE PSYCHROMETRICS - ALTERNATIVE 2  
NEW CHILLER

----- PSYCHROMETRIC STATE POINTS -----

Zone 1

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.2	50.9	75.4	30.5	
Main System						
Return Air Heat Pickup						2.6
Return Fan						0.0
Return Air	80.6	66.0	46.8	75.4	31.1	
Outdoor Air	95.5	78.6	48.2	126.0	42.8	
Return/Outdoor Air Mix	82.6	67.9	47.7	82.1	32.7	
Blow through Fan						0.0
Entering Coil	82.6	67.9	47.7	82.1	32.7	
Leaving Coil	60.4	58.4	89.6	72.5	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.5	72.5	26.2	
Supply Air	62.0	59.0	84.5	72.5	26.2	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

ZONE PSYCHROMETRICS - ALTERNATIVE 2  
NEW CHILLER

----- PSYCHROMETRIC STATE POINTS -----

Zone 2

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.2	50.9	75.4	30.5	
Main System						
Return Air Heat Pickup						2.6
Return Fan						0.0
Return Air	80.6	66.0	46.8	75.4	31.1	
Outdoor Air	95.5	78.6	48.2	126.0	42.8	
Return/Outdoor Air Mix	82.6	67.9	47.7	82.1	32.7	
Blow through Fan						0.0
Entering Coil	82.6	67.9	47.7	82.1	32.7	
Leaving Coil	60.4	58.4	89.6	72.5	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.5	72.5	26.2	
Supply Air	62.0	59.0	84.5	72.5	26.2	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

ZONE PSYCHROMETRICS - ALTERNATIVE 2  
NEW CHILLER

----- PSYCHROMETRIC STATE POINTS -----

Zone 3

	Dry Bulb (F)	Wet Bulb (F)	Relat. Humid. (%)	Humid. Ratio (GR)	Enthalpy (Btu/Lb)	Temp. Diff. (F)
Space	78.0	65.1	50.7	75.1	30.5	
Main System						
Return Air Heat Pickup						2.6
Return Fan						0.0
Return Air	80.6	65.9	46.6	75.1	31.1	
Outdoor Air	96.1	77.8	44.8	119.0	41.8	
Return/Outdoor Air Mix	82.6	67.7	46.9	80.9	32.5	
Blow through Fan						0.0
Entering Coil	82.6	67.7	46.9	80.9	32.5	
Leaving Coil	60.4	58.4	89.2	72.2	25.7	
Draw Through Fan						0.7
Duct Frictional Heat						0.9
Supply Duct Heat Gain						0.0
Cold Deck Supply Air	62.0	59.0	84.2	72.2	26.1	
Supply Air	62.0	59.0	84.2	72.2	26.1	
Percent Outside Air	13.33	(%)				
Sensible Heat Ratio (SHR)	0.884					
Percent Supply Air Bypassing Coil	0.00	(%)				
Coil Airflow	90,000	(Cfm)				

BUILDING U-VALUES - ALTERNATIVE 2  
NEW CHILLER

----- B U I L D I N G U - V A L U E S -----

Room Number	Description	Part.	ExFlr	Room U-Values (Btu/hr/sqft/F)							Room Mass (lb/ sqft)	Room Capac. (Btu/ sqft/F)
				Summr Skylt	Wintr Skylt	Roof	Summr Windo	Wintr Windo	Wall	Cell.		
1	FIRST FLOOR	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17
Zone 1	Total/Ave.	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17
2	FIRST FLOOR	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17
Zone 2	Total/Ave.	0.000	0.000	0.000	0.000	0.000	1.070	1.175	0.150	0.317	15.9	3.17
3	FIRST FLOOR	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	33.7	7.63
Zone 3	Total/Ave.	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	33.7	7.63
System 1	Total/Ave.	0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	21.8	4.66
Building		0.000	0.000	0.000	0.000	0.070	1.070	1.175	0.150	0.317	21.8	4.66

BUILDING AREAS - ALTERNATIVE 2  
NEW CHILLER

----- B U I L D I N G A R E A S -----

Room Number	Description	Number of Duplicate		Floor Area/Dupl Room (sqft)	Total Floor Area (sqft)	Partition Area (sqft)	Exposed Floor Area (sqft)	Skylight Area (sqft)	Skl /Rf (%)	Net Roof Area (sqft)	Window Area (sqft)	Win /Wl (%)	Net Wall Area (sqft)
		Flr	Rm										
Zone 1	FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	0	3,360	15	19,040
	1 Total/Ave.				120,000	0	0	0	0	0	3,360	15	19,040
Zone 2	FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	0	3,360	15	19,040
	2 Total/Ave.				120,000	0	0	0	0	0	3,360	15	19,040
Zone 3	FIRST FLOOR	1	1	120,000	120,000	0	0	0	0	120,000	3,360	15	19,040
	3 Total/Ave.				120,000	0	0	0	0	120,000	3,360	15	19,040
System	1 Total/Ave.				360,000	0	0	0	0	120,000	10,080	15	57,120
Building					360,000	0	0	0	0	120,000	10,080	15	57,120



MONTHLY ENERGY CONSUMPTION - ALTERNATIVE 2

----- MONTHLY ENERGY CONSUMPTION -----

Month	ELEC	DEMAND	WATER
	On Peak (kWh)	On Peak (kW)	
		(1000 GL)	
Jan	557,567	1,105	218
Feb	498,026	1,080	181
March	625,567	1,141	338
April	656,611	1,169	445
May	696,679	1,197	572
June	683,204	1,213	622
July	715,067	1,231	709
Aug	717,471	1,249	719
Sept	684,329	1,234	621
Oct	638,361	1,171	406
Nov	609,005	1,143	316
Dec	566,611	1,117	210
Total	7,648,496	1,249	5,356

Building Energy Consumption = 72,512 (Btu/Sq Ft/Year)  
Source Energy Consumption = 217,558 (Btu/Sq Ft/Year)

Floor Area = 360,000 (Sq Ft)

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

----- EQUIPMENT ENERGY CONSUMPTION -----

Ref Num	Equip Code	----- Monthly Consumption -----												Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
0	LIGHTS													
	ELEC	146581	132396	146581	141852	146581	141852	146581	146581	141852	146581	141853	146581	1,725,872
	PK	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8	372.8
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MISC LD													
	P HOTW20	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ1001S	2-STG CTV <555 TONS												
	ELEC	33091	28407	48808	64079	84396	90672	102784	105188	91797	56575	45986	32732	784,515
	PK	106.3	114.8	142.2	170.4	198.2	214.1	232.6	250.3	234.9	172.6	144.4	118.8	250.3
1	EQ5100	COOLING TOWER												
	ELEC	11891	1265	28481	38911	40209	38911	40209	40209	38911	33507	32426	15344	360,274
	PK	54.0	20.4	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
1	EQ5100	COOLING TOWER												
	WATER	218	181	338	445	572	622	709	719	621	406	316	210	5,356
	PK	0.8	0.9	1.2	1.4	1.5	1.6	1.7	1.8	1.8	1.4	1.2	1.0	1.8
1	EQ5001	CHILLED WATER PUMP C.V.												
	ELEC	61275	59298	87535	101654	105042	101654	105042	105042	101654	87535	84712	65652	1,066,096
	PK	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2
1	EQ5010	CONDENSER WATER PUMP C.V.												
	ELEC	21576	20880	30822	35794	36987	35794	36987	36987	35794	30822	29828	23117	375,386
	PK	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7	49.7
	EQ5300	CONTROL PANEL & INTERLOCK												

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2

	ELEC	434	420	620	720	744	720	744	744	720	620	600	465	7,551
	PK	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1	EQ4003	FC CENTRIF. FAN C.V.												
	ELEC	282720	255360	282720	273600	282720	273600	282720	282720	273600	282720	273600	282720	3,328,800
	PK	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0

UTILITY PEAK CHECKSUMS - ALTERNATIVE 2

----- U T I L I T Y   P E A K   C H E C K S U M S -----

Utility    ELECTRIC DEMAND

Peak Value    1,249.0    (kW)  
Yearly Time of Peak    15 (hr)    8 (mo)

Hour 15    Month 8

Eqp. Ref. Num.	Equipment Code Name	Equipment Description	Utility Demand (kW)	Perct Of Tot (%)
Cooling Equipment				
1	EQ1001S	2-STG CTV <555 TONS	496.3	39.73
Sub Total			496.3	39.73
Sub Total			0.0	0.00
Air Moving Equipment				
1	SUMMATION OF FAN ELECTRICAL DEMAND		380.0	30.42
Sub Total			380.0	30.42
Total			0.0	0.00
Miscellaneous				
Lights			372.8	29.85
Base Utilities			0.0	0.00
Misc Equipment			0.0	0.00
Sub Total			372.8	29.85
Grand Total			1,249.0	100.00

---

# Texas Trane - Fort Worth

## Facsimile Cover Sheet

**To:** Scott Clark  
**Company:** Carter & Burgess  
**Phone:** 817-735-6038  
**Fax:** 817-735-6064

**From:** Arthur Murnan  
**Company:** Texas Trane  
**Phone:** 817-838-1301  
**Fax:** 817-831-8135

**Date:** October 11, 1993  
**Pages including this  
cover page:** 13

**Comments:**

Here is the information you requested. The Trane Centravac will cost about \$235,000.

PROJECT : HOSPITAL CHILLER REPLACEMENT  
LOCATION : FORT SAM HOUSTON - SAN ANTONIO  
BLDG. OWNER : U.S. ARMY  
PROGRAM USER : MURNAN  
COMMENTS : SCOTT CLARK - CARTER & BURGESS  
MACHINE : CVHF

TECU 28

TECU 28

\*\*\*\*\* INPUT CONDITIONS \*\*\*\*\*

DESIGN DUTY	710		
EXITING EVAP TEMP	44	ENTERING COND TEMP	85
EVAP FLOW RATE	2260	COND FLOW RATE	2830
EVAPORATOR PASSES	2	CONDENSER PASSES	2
MAX EVAP PRESSURE DROP	33	MAX COND PRESSURE DROP	24
FLUID TYPE	WATER	FLUID TYPE	WATER
FLUID %	0	FLUID %	0
VOLTAGE	4160		
FREQUENCY	60		
REFRIGERANT	123		

\*\*\*\*\* OUTPUT DATA \*\*\*\*\*  
NOTE - PERFORMANCE CERTIFIED IN ACCORDANCE WITH ARI STANDARD 550-92  
NOTE - EXTENDED SHELL SELECTION.

%LOAD		100%	75%	50%	25%	
DESIGN DUTY	TONS	710	533	355	178	
POWER CONSUMED	KW	383	256	171	100	
KW PER DESIGN DUTY		0.539	0.481	0.482	0.563	
APLV		0.498				
EXIT EVAP TEMP	F	44.00				
EVAP FLOW RATE	GPM	2260.0	44.00	44.00	44.00	
ENTERING EVAP TEMP	F	51.54				
EVAP PD (NON-MAR)	FEET	29.67				
EVAP PD (MARINE)	FEET	30.33				
EVAP FOULING FACTOR		0.00025				
FLUID TYPE AND %	WATER	0				
ENTERING COND TEMP	F	85.00	78.75	72.50	66.25	
COND FLOW RATE	GPM	2830.0				
EXIT COND TEMP	F	91.97				
COND PD (NON-MAR)	FEET	20.60				
COND PD (MARINE)	FEET	21.64				
COND FOULING FACTOR		0.00025				
FLUID TYPE AND %	WATER	0				
MAX LRA AT MOTOR KW	AMPS	405				
RLA AT MOTOR KW	AMPS	62				
RLA AT SELECTION KW	AMPS	59				
REFRIGERANT CHARGE	LBS	1600				
SHIP WT. (W/NMAR WB.)	LBS	30721				
OPER WT. (W/NMAR WB.)	LBS	35397				
mod1-CVHF	nton-650	volt-4160	hrtz-60	type-SNGL	cpkw-403	cpim-275
evtm-TECU	evth-28	evsz-142M	evbs-980	evwp-2	orsz-880	refg-123
cdtm-TECU	cdth-28	cdsz-142S	cdbs-1220	cdwp-2	cdty-STD	

OCT-11-1993 13:29 TRANE CO

787 2166 P.04

**TRADE CENTRAVAC**

ARCHITECT: *(Signature)*

ENGINEER: *(Signature)*

PROJECT AND LOCATION: **SAN ANTONIO, TEXAS**

**BROOKE ARMY MEDICAL CENTER**

ORDER DATE: **7-9-73** CUSTOMER ORDER NO.: **1535** CUSTOMER ACCOUNT NO.: **L6-81-7399-9**

DATA SHEET: **787 2166**

TERMINAL DATE KEY: **NCT 30** F.O.B.: **LAX FRT. ALL'D**

MARK PACKAGES: **BROOKS ARMY MEDICAL CENTER MARK B/L: CALL 826-3271 24 HRS. BEFORE ATTEMPTING DELIVERY.**

SHIP VIA: **TRUCK-CALL TRAFFIC FOR ROUTING-SEE ABOVE**

COLLECT PSE: ☐

**L.C. MOSEL CO.**  
P.O. BOX 12070  
SAN ANTONIO, TEXAS 78212

**L.C. MOSEL CO.**  
C/O BROOKE ARMY MEDICAL CENTER  
FT. SAM HOUSTON  
SAN ANTONIO, TEXAS 78234

<b>TAB CHILLER 1</b>		SUBMITTAL BEARING: <b>04513-7105</b>		STD. WOOD-MOUNTING		ORDERING NO.: <b>70550346</b>	CYN 47																
MODEL: <b>PCV-40</b>		COMPA.: <b>59</b> AMP: <b>4160</b> 20/2 3600 RPM LA		PURGE UNIT: <b>480</b> 110/20/1 1800 RPM		<b>70550008</b>																	
DESIGN CAPACITY: <b>436</b> TONS REQUIRING: <b>432</b> KW 4 GPM AUL' CH. WATER		OIL PUMP: <b>480</b> 110/20/1 1800 RPM		CENT. E' BYT		Comp. Motor Dsg.																	
<table border="1"> <thead> <tr> <th>ENTERING WATER</th> <th>LEAVING WATER</th> <th>GPM</th> <th>PRESSURE DROP</th> <th>POULING FACTOR</th> <th>BIRING REGIMINATION</th> </tr> </thead> <tbody> <tr> <td>EVAP. 54 °F</td> <td>48.8 °F</td> <td>2260</td> <td>17 FT.</td> <td>.0005</td> <td>1 PASS</td> </tr> <tr> <td>COND. 85 °F</td> <td>95 °F</td> <td>1415</td> <td>19 FT.</td> <td>.001</td> <td>2 PASS LH</td> </tr> </tbody> </table>		ENTERING WATER	LEAVING WATER	GPM	PRESSURE DROP	POULING FACTOR		BIRING REGIMINATION	EVAP. 54 °F	48.8 °F	2260	17 FT.	.0005	1 PASS	COND. 85 °F	95 °F	1415	19 FT.	.001	2 PASS LH	SPECIAL FEATURES		Motor Dsg. <b>A4516-9678-5</b> Impeller <b>29.0</b> C-2 D-2 Conn. Ext. <b>K-5</b> Lead Limit Relay <b>5.79</b> Sup. LTC Setting <b>37</b> FOR SRS 1411.00
ENTERING WATER	LEAVING WATER	GPM	PRESSURE DROP	POULING FACTOR	BIRING REGIMINATION																		
EVAP. 54 °F	48.8 °F	2260	17 FT.	.0005	1 PASS																		
COND. 85 °F	95 °F	1415	19 FT.	.001	2 PASS LH																		
COMPRESSOR MOTOR STARTER <b>3</b> FULL VOLTAGE 12-120V 0 AUTO TRANSFORMER 17 OPEN <input type="checkbox"/> CLOSED TRANSITION STAR DELTA <input type="checkbox"/> PRIMARY REACTOR <b>4160</b> 60 <b>3</b> 39 <b>283</b> 62 <b>50</b> SPECIAL FEATURES <b>ORD. FOR DIRECT SHIPMENT</b>		B4517		PURCHASE C.O. TO <b>7528000 13170063 13040029 0857-1</b>		<b>715</b>  <b>L6-E 2</b>  <b>1</b>																	
NEEDLE BALL-BE PRESSURE ELECTRIC SWITCH TEMPERATURE CONTROLLED FLOW SWITCH 150 PSI NEMA 1 NAMEPLATE		880 POUNDS REPRESENTATIVE SHIPMENT.		PURCHASE C.O. TO <b>7528000 13170063 13040029 0857-1</b>																			
ENTERED: <b>662</b>		ORDER CLASS: <b>H-231</b>		OFFICE SALES: <b>SNOW L6-C66</b>																			

FILE COPY

710 tons  
2260 GPM  
27 Ft. Evap P.D.  
19 Ft. Cond P.D.  
2830 GPM

*As a result of*

*FILE COPY*

OCT-11-1993 13:28

TRANE CO

787 2166

P.03

JOB NAME AND LOCATION		Brooke Army Medical Center					ELEVATION ABOVE SEA LEVEL	S.O. NO.	L6-7231	
#1		FIFTEEN MINUTE INTERVALS					FT.	MODEL NO.	PGY-4D-U2-D2	
VOLTS		A-R	4160	4160	4160	4160	4160	4160	IMMEDIATE DATA	
A-C		4160	4160	4160	4160	4160	4160	4160	CTV	371
C-R		4160	4160	4160	4160	4160	4160	4160	PNL	4583
AMPERES LINE	1	55	35	25	20	18	18	18	WPK	118
	2	55	35	25	20	18	18	18	WPK	52
	3	55	35	25	20	18	18	18	WPK	1080
	4	55	35	25	20	18	18	18	WPK	
	5	55	35	25	20	18	18	18	WPK	
CDS WATER IN		82	86	84	80	76	78		COM	
CDS WATER OUT		92	92	90	82	78	80		EVP	
CONDENSING TEMP.		96	96	92	86	80	82		CDS	
CHILLED WATER IN		66	51	49	48	47	47		LTC	CUT OUT 32 CUT IN 42
CHILLED WATER OUT		61	48	47	47	46	46		OPC	4 8
EVAP. TEMP.		46	43	44	45	45	45		WPC	14 9
EVAP. PRESS.		15"	16"	16"	16"	16"	16"		WTC	110 105
CDS PRESS.		10#	7#	5#	3#	2.5#	3#		DIL SUMP T.C.	135 130
NET OIL PRESS.		14#	14#	14#	14#	14#	14#		OIL COOLFR T.C.	117 117
OIL TEMP. SUMP		135	135	135	135	135	135			
OIL TEMP. TO BRU.		115	117	117	117	117	117			
PRESSURE TESTED AT		8	PSIG	MOTOR DATA				STARTER DATA		
EVACUATED		.04	MM. Hg.	MFR.	Louis Allis			MFR.	General Electric	
STANDING VACUUM TEST		1.0	MM. Hg.	FRAME	RCS 1972			TYPE	X Line	
MOTOR LIQUID LEVEL		14	MIN. TO FILL	SERIAL	3385061M001			OVERLOAD SETTING	62	
REFRIG. CHARGE		800	LB.	VOLTS	4160	AMPS.	59	CTC.	60	TIME TO TRIP
CDS. PRESS. DROP		DESIGN 8.2	PSI	BEFORE BREAKING HOLDING CHARGE			PH 1	800	TRIP AMPS	62
ACTUAL 8.4		PSI	PH 2				800	"AUTO TRANS. STAR DELTA ETC.		
EVAP. PRESS. DROP		DESIGN 7.4	PSI	AFTER CHARGING WITH R-11			PH 3	800	NO. OF DAYS ON JOB	5
ACTUAL 4.0		PSI	PH 1				200	DATE STARTED	October 24, 1973	
LOAD LIMIT RELAY		AMP. SETTING 5.5					PH 2	200	SERVICE ENGR.	R. H. Schmiedt
CT RATIO 50:5							PH 3	200	OWNER'S REPRESENTATIVE	Charles Torppenvier
NUMBER OF LEAKS FOUND, LOCATION AND COMMENTS										



OCT-11-1993 13:28 TRANE CO 787 2166 P.02  
 SELLING SALES OFFICE ~~TRANE~~ STARTING SALES OFFICE ~~TRANE~~

**CENTRAVAC INSPECTION, SHIPMENT, AND START-UP ASSIGNMENT RECORD**

JOB NAME Beck's Home Air Conditioning UNIT SERIAL NO. 16786  
 LOCATION Spa, Auburn, Texas SALES ORDER NO. 26-2291  
 SOLD TO A.C. Hise Co. SHIPMENT DATE \_\_\_\_\_  
 DWG. LIST 4516-9678 START-UP DATE 10-24-73  
 SIZE Rev. 42 C-2 D-3-29.0

MOTOR AND STARTER INFORMATION 50-5										
DESCRIPTION & CODE	SERIAL NO.	MGR.	FRAME	BHP/KW	FLA	LRA	VOLTS	CYCLES	PHASE	
Compressor Motor 4516-9678	37854611001	LA	PLS1972	-	59	223	4160	60	3	
Oil Pump Motor 4516-9678		CEUT	F4817	1/4	52	2.88	480	60	3	
Purge Unit Motor	N-3	CEUT	G48	1/4	6.0	-	115	60	1	
Compressor Starter										

UNIT MODEL NUMBERS				EVAPORATOR	CONDENSER
General	371	Cond.		Combination	
Compr.	1080	Evap.		Pass	LH
Cnt. Panel	4583	Purge Unit	52	Special	2
Base and Tank	118	Remarks			

Tag: Chiller

COMPRESSOR AND RUN-IN TEST INFORMATION			
Date	7-2-73	Type Refrigerant	R11
Vibration Readings (.001 in. max.)	a. 1st Stage (Terminal - Hor. <u>0.005</u> Ver. <u>0.005</u> )		
	b. 2nd Stage (Compr.) Hor. <u>0.0032</u> Ver. <u>0.0029</u>		
GV Return Oil Flow @ 12 psig	a. 1st Stage Bearing <u>1</u> min. <u>1</u> sec. b. 2nd Stage Bearing <u>1</u> min. <u>1</u> sec.		
PCV Return Oil Flow @ 12 psig in 2 min.	a. Terminal Bearing <u>0.5</u> pints. b. Compressor Bearing <u>1</u> pints.		

- COMPRESSOR ASSEMBLY**
- Valve
  - Suction Cover
  - Diaphragm Plate
  - Impeller
  - Seal Clearances
  - Impeller axial clearance.
  - Motor insulation 100 megohms (10 megohms resistance minimum)
  - Cooling water of water cooled motor \_\_\_\_\_°F (110°F maximum outlet temperature)
  - Oil pump amperage 14 amps (at 12 psig oil pressure).
  - Float valve
  - Comments: 06A Tube C-2 7x14

Dept. 437 forward original to Products Engineering when complete.

INSPECTOR W. Bartlett APPROVAL FOR SHIPMENT  
 FOREMAN W. Pinto

7168



OCT-11-1993 13:30

TRANE CO

787 2166

P. 06

JOB NAME AND LOCATION		Brooke Army Medical Center San Antonio, Texas						ELEVATION ABOVE SEA LEVEL	S.O. NO.	NAMEPLATE DATA		
									16-E231	PCV-4K-CI-n1		
#2		FIFTEEN MINUTE INTERVALS						FT.	MODEL NO.	L3P16791		
VOLTS	A-B	4160	4160	4160	4160	4160	4160		CITY	372		
	A-C	4160	4160	4160	4160	4160	4160		P.N.L.	4583		
	C-B	4160	4160	4160	4160	4160	4160		K.K.F.	118		
TEMPERATURE LINE	1	58	40	40	35	30			P.H.U.	32		
	2	58	40	40	35	30			CON	1081		
	3	58	40	40	35	30			E.V.P.			
	4								C.D.S.			
	5								L.T.C.	CUT OUT	CUT IN	
	6									32	42	
COOL WATER IN		84	83	84	84	84			O.P.C.	4	8	
COOL WATER OUT		94	90	91	91	90			N.P.C.	14	9	
CONDENSING TEMP.		96	95	95	95	93			H.T.C.	110	105	
CHILLED WATER IN		55	50	46	45	43			OIL PUMP T.G.	135	130	
CHILLED WATER OUT		50	47	44	43	42			OIL COOLER T.G.	117	117	
EVAP. TEMP.		43	42	40	40	38						
EVAP. PRESS.		16"	16"	16"	16"	16"						
CDS PRESS.		10 #	8#	7.5#	7#	6#						
NET OIL PRESS.		14#	14#	14#	14#	14#						
OIL TEMP. SUMP		135	135	135	135	135						
OIL TEMP. TO BRO.		117	117	117	117	117						
PRESSURE TESTED AT		7 PSIG		MOTOR DATA				STARTER DATA				
EVACUATED		.06 MM.		MFR.	Louis Allis			MFR.	General Electric			
STANDING VACUUM TEST		1.2 MM. Hg		FRAME	RGS 1976			TYPE	X Line			
MOTOR LIQUID LEVEL		MIN. TO FILL		SERIAL	33895050001			OVERLOAD SETTING	62			
REFRIG. CHARGE		1100 LBS.		VOLTS	440		AMPS	60		TIME TO TRIP	1 Minute	
CDS. PRES. DROP	DESIGN	6.4 PSI		INSULATION RESISTANCE	BEFORE BREAKING HOLDING CHARGE	PH 1	600		TRIP AMPS	63		
	ACTUAL	6.6 PSI				PH 2	600		"AUTO TRANS. STAB DELTA ETC."			
EVAP. PRES. DROP	DESIGN	4.3 PSI		AFTER CHARGING WITH Q-11	PH 1	200		NO. OF DAYS ON JOB	3			
	ACTUAL	3.0 PSI			PH 2	200		DATE STARTED	10/24/73			
LOAD LIMIT RELAY	AMP. SETTING	5.8		PH 3	200		SERVICE ENG.	R. H. Schmidt				
	CT RATIO	50 - 5						DOWNER'S REPRESENTATIVE	Charles Torppenvier			
NUMBER OF LEAKS FOUND, LOCATION AND COMMENTS												

OCT-11-1993 13:30

TRANE CO

787 2166

P.05

STARTING SALES OFFICE

## CENTRAVAC INSPECTION, SHIPMENT, AND START-UP ASSIGNMENT RECORD

JOB NAME General EngineeringLOCATION San Antonio, TexasSOLD TO L.D. Miller Co.DWG. LIST 516-96770SIZE Rev. 44-C1-D1-300UNIT SERIAL NO. 16791SALES ORDER NO. 46-22913

SHIPMENT DATE

START-UP DATE 7-17-7310-24-73

DESCRIPTION & CODE		SERIAL NO.	MOTOR AND STARTER INFORMATION							5.92
			MGR.	FRAME	BHP/KW	FLA	LRA	VOLTS	CYCLES	PHASE
Compressor Motor	3387505/1001	LA	PC1970			60	350	460	60	3
Oil Pump Motor	N-2	Cent	F4871	1/4	1/2	52	128	480	60	3
Purge Unit Motor	N-3	Cent	G48	1/2	1/2	6.0		115	60	1
Compressor Starter										

UNIT MODEL NUMBERS				EVAPORATOR		CONDENSER	
General	372	Cond.		Combination			
Compr.	1081	Evap.		Pass		RH	
Ctrl. Panel	4583	Purge Unit	52	Special		2	
Base and Tank	118	Remarks					

Tag: Chiller 2

COMPRESSOR AND RUN-IN TEST INFORMATION			
Date	7-5-73	Type Refrigerant	R11
Vibration Readings (.001 in. max.)		a. 1st Stage (Terminal - Hor.)	Hor. 0006 Vert. 00054
		b. 2nd Stage (Compr.)	Hor. 00034 Vert. 00032
CTV Return Oil Flow @ 12 psig.		a. 1st Stage Bearing	min. 7 sec. 6 sec. max. and
		b. 2nd Stage Bearing	min. 7 sec. 20 min. min.
PCV Return Oil Flow @ 12 psig in 2 min.	Static	a. Terminal Bearing	min. 4 pints min. & max. f.
		b. Compressor Bearing	min. 3 pints min. & max. f.

## COMPRESSOR ASSEMBLY

1. Valve
2. Suction Cover
3. Diaphragm Plate
4. Impeller
5. Seal Clearances
  - a. 1st Stage Dwg. No. 4513-2845
  - b. 2nd Stage Dwg. No. 4513-2065
  - a. 1st Stage Dwg. No. 4513-2957
  - b. 2nd Stage Dwg. No. 4516-4256
  - a. 1st Stage Dwg. No. 4513-5845
  - b. 2nd Stage Dwg. No. 4513-8449
  - a. Shaft Seal - 1st stage 003
  - b. Impeller Seal - 1st stage 017-019
  - a. 2nd stage 004
  - b. 2nd stage 017-019
6. Impeller axial clearance.
7. Motor insulation 100 megohms (10 megohms resistance minimum)
8. Cooling water of water cooled motor --- "F 110°F maximum outlet temperature)
9. Oil pump amperage 14 amps (at 12 psig oil pressure).
10. Float valve
11. Comments add tube code 7x14

Dept. 437 forward original to Products Engineering when complete.

INSPECTOR

Charles

APPROVAL FOR SHIPMENT

FOREMAN

McBrito

71.04

## GENERAL DATA

ABLE 18-1 — General Data

Model	CGAA 100 J	CGAA 150 J	CGAA 200 M	CGAA 250 M	CGAA 300 M	CGAA 400 F	CGAA 400 M
Compressor	CRHJ-050	CRHJ-075	CRHM 200	CRHM 250	CRHM 300	2FSC88	2-CRHM 200
Unit Capacity Steps %	100-50	100-50	100-50-25	100-65-33	100-65-33	100-75-50-25	100-75-50-25
Condenser <sup>1</sup>	CDS 286	CDS 287	CDS 272 (RH) CDS 273 (LH)	CDS 274 (RH) CDS 275 (LH)	CDS 276 (RH) CDS 277 (LH)	CDS 278 (RH) CDS 279 (LH)	CDS 278 (RH) CDS 279 (LH)
Coil (H x L) Each	21 x 168	24 x 203	30 x 53	30 x 77	30 x 77	45 x 70	45 x 70
Subcooler (H x L) Each	3 x 168	6 x 203	5 x 53	5 x 77	5 x 77	6.25 x 70	6.25 x 70
Total Face Area Ft. <sup>2</sup>	28	42.3	25.78	37.45	37.45	49.83	49.83
Coil Rows Each	1	1	3	2	3	3	3
Condenser Fans	2-24" Prop.	3-24" Prop.	2-28" Prop.	3-28" Prop.	3-28" Prop.	4-28" Prop.	4-28" Prop.
CFM (Total)	8,450	12,650	12,400	19,250	19,250	24,500	24,500
Nominal RPM	825	825	1,140	1,140	1,140	1,140	1,140
Tip Speed FPM	5,190	5,190	7,750	7,750	7,750	7,750	7,750
HP (Each)	1/8	1/8	1	1	1	1	1
Drive	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Evaporator	EVP 295	EVP 295	EVP 297	EVP 298	EVP 299	EVP 301	EVP 300
Gal. H <sub>2</sub> O (Evap. + Unit Piping)	7	9	10.8	22.2	20.4	34.3	34.3
Min. Startup °F (Std.)	35°	35°	45°	45°	45°	45°	45°
(Low Ambient)	0	0	0	0	0	0	0
Std. Unit Operation							
Fans on Above 65 F	2	3	2	3	3	4	4
Fans on 65-45 F	1	2	1	2	2	2	2
Fans on 45-35 F	1	1	0	1	1	1	0
Unit Cut Off Temp °F (Std.)	35°	35°	45°	45°	45°	45°	45°
Low Ambient Unit Oper.							
Fans on Above 65 F	1	3	2	3	3	4	4
Fans on 65-45 F	1	2	—	2	2	2	2
Fans on 45-0 F	1	2	—	—	—	—	—
<sup>2</sup> Fans Modulate 65-0 F	—	—	1	—	—	—	—
<sup>2</sup> Fans Modulate 45-0 F	—	—	—	1	1	1	2
Unit Cut Off Temp °F (Low Ambient)	0	0	0	0	0	0	0
Std and Low Ambient							
R-22 Charge (Lbs.)	20	27.5	31	37	46	60	60
Total Unit Operating Wt.							
Incl. Refrigerant (Lbs.)	1,090	1,316	1,950	2,300	2,450	4,075	4,075
Shipping Weight (Lbs.)	1,125	1,250	1,990	2,285	2,440	3,990	3,990

Model	CGAA 500 E	CGAA 500 M	CGAA 600 M	CGAA 750 E	CGAA 1000 E	CGAA 1200 R
Compressor	2ESF48	2-CRHM 250	2-CRHM 300	2ESG68	2ESG88	2-CRHR 500
Unit Capacity Steps %	100-75-50-25	100-63-50-33	100-63-50-33	100-67-50-33	100-75-50-37	100-83-50-33
Condenser <sup>1</sup>	CDS 280 (RH) CDS 281 (LH)	CDS 280 (RH) CDS 281 (LH)	CDS 282 (RH) CDS 283 (LH)	CDS 290 (RH) CDS 291 (LH)	CDS 292 (RH) CDS 293 (LH)	CDS 294 (RH) CDS 295 (LH)
Coil (H x L) Each	48.75 x 95	48.75 x 95	50 x 95	47.25 x 162	47.25 x 200	49.5 x 200
Subcooler (H x L) Each	7.5 x 95	7.5 x 95	8.25 x 95	6.75 x 162	6.75 x 200	7.5 x 200
Total Face Area Ft. <sup>2</sup>	74.2	74.2	74.2	121.5	150	156
Coil Rows Each	2	2	3	2	2	3
Condenser Fans	5-28" Prop.	5-28" Prop.	5-28" Prop.	2-48" Prop.	3-48" Prop.	3-48" Prop.
CFM (Total)	38,500	38,500	36,900	53,200	76,900	73,200
Nominal RPM	1,140	1,140	1,140	610	610	610
Tip Speed FPM	7,750	7,750	7,750	7,660	7,660	7,880
HP (Each)	1	1	1	7.5	7.5	7.5
Drive	Direct	Direct	Direct	Belt	Belt	Belt
Evaporator	EVP 303	EVP 302	EVP 304	EVP 307	EVP 308	EVP 309
Gal. H <sub>2</sub> O (Evap. + Unit Piping)	33.6	33.6	29.4	45	52	60
Min. Startup °F (Std.)	45°	45°	45°	30°	30°	25°
(Low Ambient)	0	0	0	0	0	0
Std. Unit Operation						
Fans on Above 65 F	6	6	8	2	3	3
Fans on 65-45 F	4	4	4	1	2	2
Fans on 45-35 F	2	2	2	1	1	1
Unit Cut Off Temp °F (Std.)	45°	45°	45°	30°	30°	25°
Low Ambient Unit Oper.						
Fans on Above 65 F	6	6	6	2	3	3
Fans on 65-45 F	4	4	4	1	2	2
Fans on 45-0 F	—	—	—	—	—	—
<sup>2</sup> Fans Modulate 65-0 F	—	—	—	—	—	—
<sup>2</sup> Fans Modulate 45-0 F	1	2	2	—	—	—
Unit Cut Off Temp °F (Low Ambient)	0	0	0	0	0	0
Std and Low Ambient						
R-22 Charge (Lbs.)	72	72	92	180	210	310
Total Unit Operating Wt.						
Incl. Refrigerant (Lbs.)	4,810	4,500	4,760	7,825	8,850	10,450
Shipping Weight (Lbs.)	4,755	4,445	4,730	7,780	8,970	10,470

TES: 1. Right (RH) and Left Hand (LH) condenser coils determined by viewing unit from compressor end.  
2. 200, 230, 460 V units only.

TABLE 16-1 — Electrical Data

Model	Unit Characteristics (1)						Circuit Characteristics (2)				Compressor				Condenser Fan Motors		
	Line Volts (3)	Voltage Range	Wire Sizing Amps (4)	Max. Inrush Amps (5)	Max. Fuse (6)	Recommended Dual Element Fuse (6)	Comp. Ckts. (Per Comp.)		Fan/Control Circuit		No.	Type Start	FLA Ea. (7)	LRA Ea. (8)	No.	FLA Ea.	KW Ea.
							Wire Sizing Amps (4)	Max. Fuse (6)	Wire Sizing Amps (4)	Max. Fuse (6)							
CGAA-1006-J	208/240	187-264	63	138	80	60	—	—	—	—	2	XL	24.3	129	2	2.3	1/2 H.P.
CGAA 1004-J	440/480	408-528	31	72	40	30	—	—	—	—	2	XL	12.2	66	2	1.3	1/2 H.P.
CGAA 1806-J	208/240	187-264	98	178	110	80	—	—	—	—	2	XL	37.8	169	3	2.3	1/2 H.P.
CGAA 1504-J	440/480	408-528	47	91	60	50	—	—	—	—	2	XL	18.9	85	3	1.3	1/2 H.P.
CGAA 2006-M	200	180-220	127	299	200	150	—	—	—	—	1	PW	82	396/241	2	6.0	1.2
CGAA 2003-M	230	207-253	111	260	175	125	—	—	—	—	1	PW	80	345/210	2	5.2	1.2
CGAA 2004-M	480	414-506	58	198	90	80	—	—	—	—	1	XL	40	173	2	2.6	1.2
CGAA 2001-M	480	414-506	58	130	90	60	—	—	—	—	1	PW	40	173/105	2	2.6	1.2
CGAA 2005-M	575	517-633	46	156	70	50	—	—	—	—	1	XL	33	138	2	2.0	1.2
CGAA 2002-M	575	517-633	46	100	70	50	—	—	—	—	1	PW	33	138/84	2	2.0	1.2
CGAA 2506-M	200	180-220	163	363	250	175	—	—	—	—	1	PW	116	483/276	3	6.0	1.2
CGAA 2503-M	230	207-253	141	315	225	150	—	—	—	—	1	PW	100	420/240	3	5.2	1.2
CGAA 2504-M	480	414-506	71	248	110	80	—	—	—	—	1	XL	50	210	3	2.6	1.2
CGAA 2501-M	480	414-506	71	158	110	80	—	—	—	—	1	PW	50	210/120	3	2.6	1.2
CGAA 2505-M	575	517-633	56	192	90	80	—	—	—	—	1	XL	40	168	3	2.0	1.2
CGAA 2502-M	575	517-633	56	120	90	60	—	—	—	—	1	PW	40	168/96	3	2.0	1.2
CGAA 3006-M	200	180-220	186	409	300	200	—	—	—	—	1	PW	134	551/322	3	6.0	1.2
CGAA 3003-M	230	207-253	161	355	250	175	—	—	—	—	1	PW	116	480/280	3	5.2	1.2
CGAA 3004-M	480	414-506	81	278	125	90	—	—	—	—	1	XL	58	240	3	2.8	1.2
CGAA 3001-M	480	414-506	81	178	125	90	—	—	—	—	1	PW	58	240/140	3	2.8	1.2
CGAA 3005-M	575	517-633	85	216	110	70	—	—	—	—	1	XL	47	192	3	2.0	1.2
CGAA 3002-M	575	517-633	85	138	110	70	—	—	—	—	1	PW	47	192/112	3	2.0	1.2
CGAA 4006-F	200	187-220	204	506	300	225	—	—	—	—	1	PW	144	533/390	4	6.0	1.2
CGAA 4003-F	230	207-253	185	550	300	200	—	—	—	—	1	PW	130	614/450	4	5.2	1.2
CGAA 4004-F	480	414-506	92	357	150	110	—	—	—	—	1	XL	65	307	4	2.8	1.2
CGAA 4001-F	480	414-506	92	275	150	110	—	—	—	—	1	PW	65	307/225	4	2.8	1.2
CGAA 4005-F	575	517-633	78	258	125	90	—	—	—	—	1	XL	55	226	4	2.0	1.2
CGAA 4002-F	575	517-633	78	197	125	90	—	—	—	—	1	PW	65	226/185	4	2.0	1.2
CGAA 4006-M	200	180-220	233	299	—	—	115	200	29	45	2	PW	92	396/241	4	6.0	1.2
CGAA 4003-M	230	207-253	203	260	—	—	100	175	26	40	2	PW	80	345/210	4	5.2	1.2
CGAA 4004-M	480	414-506	102	198	—	—	50	90	13	20	2	XL	40	173	4	2.6	1.2
CGAA 4001-M	480	414-506	102	130	—	—	50	90	13	20	2	PW	40	173/105	4	2.6	1.2
CGAA 4005-M	575	517-633	84	156	—	—	42	70	10	15	2	XL	33	138	4	2.0	1.2
CGAA 4002-M	575	517-633	84	100	—	—	42	70	10	15	2	PW	33	138/84	4	2.0	1.2
CGAA 5006-E	200	187-220	250	614	400	250	—	—	—	—	1	PW	171	652/440	6	6.0	1.2
CGAA 5003-E	230	207-253	222	555	350	250	—	—	—	—	1	PW	155	750/505	6	5.2	1.2
CGAA 5004-E	480	414-506	114	450	175	125	—	—	—	—	1	XL	78	375	6	2.6	1.2
CGAA 5001-E	480	414-506	114	328	175	125	—	—	—	—	1	PW	78	375/253	6	2.6	1.2
CGAA 5005-E	575	517-633	94	322	125	110	—	—	—	—	1	XL	65	274	6	2.0	1.2
CGAA 5002-E	575	517-633	94	233	125	110	—	—	—	—	1	PW	65	274/185	6	2.0	1.2
CGAA 5006-M	200	180-220	299	363	—	—	145	250	41	50	2	PW	116	483/276	6	6.0	1.2
CGAA 5003-M	230	207-253	260	315	—	—	125	225	36	45	2	PW	100	420/240	6	5.2	1.2
CGAA 5004-M	480	414-506	130	248	—	—	63	110	18	25	2	XL	50	210	6	2.6	1.2
CGAA 5001-M	480	414-506	130	158	—	—	63	110	18	25	2	PW	50	210/120	6	2.6	1.2
CGAA 5005-M	575	517-633	104	192	—	—	50	90	15	20	2	XL	40	168	6	2.0	1.2
CGAA 5002-M	575	517-633	104	120	—	—	50	90	15	20	2	PW	40	168/96	6	2.0	1.2

TABLE 16-1 — Electrical Data (Continued)

Model	Unit Characteristics (1)						Circuit Characteristics (2)				Compressor				Condenser Fan Motors		
	Line Volt (3)	Voltage Range	Wire Sizing Amps (4)	Max. Inrush Amps (5)	Max. Fuse (6)	Recommended Dual Element Fuse (6)	Comp. Ckt. (Per Comp.)		Fan/Control Circuit		No.	Type	FLA Ea. (7)	LRA Ea. (8)	No.	FLA Ea.	KW Ea.
							Wire Sizing Amps (4)	Max. Fuse (6)	Wire Sizing Amps (4)	Max. Fuse (6)							
CGAA 6006-M	200	180-220	339	409	—	—	168	300	41	50	2	PW	134	551/322	6	6.0	1.2
CGAA 6003-M	230	207-253	294	355	—	—	145	250	36	45	2	PW	116	480/280	6	5.2	1.2
CGAA 6004-M	460	414-506	148	278	—	—	73	125	18	25	2	XL	58	240	6	2.6	1.2
CGAA 6001-M	460	414-506	148	178	—	—	73	125	18	25	2	PW	58	240/140	6	2.6	1.2
CGAA 6005-M	575	517-633	120	216	—	—	59	100	15	20	2	XL	47	192	6	2.0	1.2
CGAA 6002-M	575	517-633	120	136	—	—	59	100	15	20	2	PW	47	192-112	6	2.0	1.2
CGAA 7506-E	200	187-220	381	987	600	400	—	—	—	—	1	PW	264	958/715	2	25.3	8.5
CGAA 7503-E	230	207-253	354	1062	600	400	—	—	—	—	1	PW	248	1100/822	2	22	6.6
CGAA 7504-E	460	414-506	177	610	300	200	—	—	—	—	1	XL	124	550	2	11	5.5
CGAA 7501-E	460	414-506	177	531	300	200	—	—	—	—	1	PW	124	550/411	2	11	5.5
CGAA 7505-E	575	517-633	145	496	225	150	—	—	—	—	1	XL	101	400	2	9	5.5
CGAA 7502-E	575	517-633	145	397	225	150	—	—	—	—	1	PW	101	400/301	2	9	5.5
CGAA 10006-E	200	187-220	505	1308	800	500	—	—	—	—	1	PW	342	1320/900	3	25.3	8.5
CGAA 10003-E	230	207-253	454	1395	700	500	—	—	—	—	1	PW	310	1520/1035	3	22	5.5
CGAA 10004-E	460	414-506	227	940	350	250	—	—	—	—	1	XL	155	760	3	11	5.5
CGAA 10001-E	460	414-506	227	696	350	250	—	—	—	—	1	PW	155	760/518	3	11	5.5
CGAA 10005-E	575	517-633	191	699	300	200	—	—	—	—	1	XL	131	655	3	9	5.5
CGAA 10002-E	575	517-633	191	523	300	200	—	—	—	—	1	PW	131	565/379	3	9	5.5
CGAA 12006-R	200	180-220	589	1028	—	—	285	500	86	150	2	PW	228	990/620	3	25.3	8.5
CGAA 12003-R	230	207-253	512	895	—	—	248	400	75	125	2	PW	198	860/542	3	22	5.5
CGAA 12004-R	460	414-506	256	610	—	—	124	200	38	60	2	XL	99	430	3	11	5.5
CGAA 12001-R	460	414-506	256	468	—	—	124	200	38	60	2	PW	99	430/278	3	11	5.5
CGAA 12005-R	575	517-633	207	490	—	—	100	175	31	50	2	XL	80	348	3	9	5.5
CGAA 12002-R	575	517-633	207	364	—	—	100	175	31	50	2	PW	80	348/220	3	9	5.5

## NOTES:

- Unit characteristics refer to entire unit considering single electrical source.
- Circuit characteristics refer to individual electrical sources to dual compressor units.
- Line voltage 3 phase 60 Hz. All motors 3 phase 60 Hz except variable speed PSC fan motors on 200, 230/460 volt Low Ambient (20-80 ton) units. Single phase power for these motor(s) and associated controls taken off internally and factory wired. 575 volt Low Ambient units (20-80 ton) use cycling 3 phase fans with dampers. Voltages available only as shown.
- Wire sizing amps per NEC 440-32 and NEC 440-33.
- Max. inrush current is peak rise or step surge of current which can occur during start (i.e., LRA of compressor first step plus LRA for all fan motors). Compressor sequence start on dual compressor units.
- Max. fuse sizing permitted by NEC 440-22 is 225% of largest component FLA plus remaining FLA. Recommended dual element fuses sized at approx. 150% of FLA of largest motor plus sum of the FLA's of the remaining motors.
- Compressor full load amps (FLA) based on the amp draw at 104 F air entering condenser; 62 F entering water and 50 F leaving water; nominal line voltage.

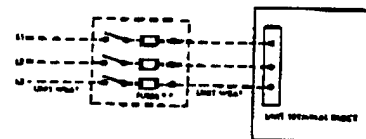
Full winding/part winding.

Voltage phase unbalance should not exceed 2%.

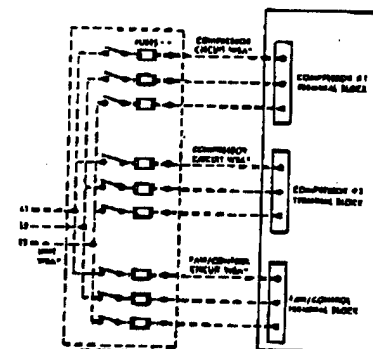
- Local codes may supersede NEC.

## Field Connections

COMPRESSOR UNITS CGAA 100-150J, 200-300M, 400F, 600-1000E



DUAL COMPRESSOR UNITS CGAA 400-600M, 1200R



\*Wire Sizing Amps - See Electrical Data Table

\*\*For Recommendations, See Electrical Data Table

TABLE 14-1 — Capacities (Continued)

CGAA - 600 E				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	43.5	104.4	44.6	40.3	96.7	47.2	37.4	89.9	49.7	34.8	83.5	51.8			
42	44.9	107.8	45.4	41.6	99.9	48.1	38.8	92.9	50.7	35.9	86.3	52.8			
44	46.3	111.3	46.2	42.9	103.1	49.0	40.0	96.0	51.6	37.0	88.9	53.7			
45	47.1	113.1	46.6	43.1	104.9	49.4	40.7	97.8	52.0	37.7	90.3	54.2			
46	47.8	114.9	46.9	44.3	106.6	49.8	41.3	99.1	52.3	38.3	91.7	54.8			
48	49.3	118.3	47.7	45.8	110.0	50.7	42.6	102.3	53.2	—	—	—			
50	50.8	121.8	48.4	47.3	113.5	51.5	44.0	105.8	54.1	—	—	—			
CGAA - 600 M				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	44.4	106.5	53.0	41.8	99.7	58.5	38.8	92.5	60.3	36.5	85.1	64.1			
42	45.9	110.2	54.1	42.9	103.0	57.7	39.9	95.8	61.4	36.8	87.9	65.5			
44	47.4	113.7	55.2	44.4	106.8	58.9	41.3	99.0	62.7	37.8	90.7	66.8			
45	48.2	115.8	55.8	45.2	108.5	59.5	42.0	100.7	63.3	38.4	92.2	67.3			
46	49.0	117.5	56.3	46.0	110.4	60.0	42.8	102.4	63.9	39.0	93.8	67.9			
48	50.8	121.4	57.3	47.5	114.0	61.2	44.1	105.7	65.1	40.2	96.8	69.1			
50	52.2	125.3	58.4	49.1	117.8	62.3	45.5	109.1	66.3	41.5	99.7	70.4			
CGAA - 800 M				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	54.0	129.4	63.8	50.5	121.2	67.3	47.0	112.8	70.8	43.5	104.2	74.1			
42	55.6	133.4	65.0	52.1	125.1	68.6	48.6	116.4	72.1	44.9	107.7	75.6			
44	57.3	137.5	66.1	53.8	128.9	69.8	50.1	120.2	73.4	46.3	111.3	77.0			
45	58.2	139.8	66.8	54.6	130.8	70.4	50.9	122.1	74.1	47.1	113.2	77.8			
46	59.0	141.8	67.1	55.3	132.8	70.9	51.6	123.9	74.8	47.9	115.1	78.8			
48	60.7	145.8	68.1	56.9	136.7	72.0	53.2	127.7	76.9	49.5	118.7	80.1			
50	62.4	149.8	69.2	58.5	140.6	73.3	54.8	131.5	77.4	51.0	122.3	81.5			
CGAA - 750 E				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	66.0	158.5	67.3	62.1	149.1	71.0	58.0	139.3	74.0	53.3	128.0	75.5			
42	68.3	164.0	68.7	64.3	154.4	72.8	60.1	144.2	75.6	55.3	132.7	77.8			
44	70.9	170.1	70.4	66.6	159.7	74.2	62.2	149.2	77.2	57.6	138.3	79.4			
45	72.1	172.9	71.2	67.7	162.4	75.0	63.3	151.8	78.0	58.6	140.6	80.1			
46	73.2	175.7	72.1	68.7	165.1	75.9	64.3	154.3	78.8	59.6	142.9	80.9			
48	75.5	181.2	73.6	71.3	171.0	77.4	66.3	159.0	80.3	—	—	—			
50	77.7	186.5	75.1	73.2	175.8	78.9	68.0	163.3	81.7	—	—	—			
CGAA - 1000 E				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	89.6	208.6	86.9	82.0	196.8	91.6	75.8	184.2	96.3	71.6	171.8	100.4			
42	90.6	217.5	88.2	84.8	203.4	93.3	79.5	190.6	98.0	74.1	177.8	102.4			
44	93.4	224.3	89.8	87.9	210.9	94.9	82.1	197.0	99.7	76.5	183.8	104.2			
45	94.9	227.7	90.1	89.3	214.3	95.5	83.5	200.2	100.4	77.8	186.4	105.1			
46	96.3	231.1	90.7	90.7	217.7	96.1	84.8	203.4	101.2	78.8	189.2	106.1			
48	99.0	237.8	92.1	93.4	224.3	97.5	87.7	210.5	102.9	—	—	—			
50	102.1	245.1	93.5	96.3	231.0	99.2	90.2	216.5	104.8	—	—	—			
CGAA - 1200 R				Temperature of air entering the condenser											
				85 F			95 F			105 F			115 F		
Leaving water temperature	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW	Tons	GPM	KW
40	109.7	263.5	115.9	103.8	248.8	122.5	97.2	233.3	128.8	90.5	217.3	134.8			
42	112.8	270.8	117.6	106.5	255.5	124.4	100.0	240.0	131.0	93.2	223.9	137.4			
44	115.5	278.4	119.3	109.9	263.7	126.4	102.8	248.8	133.2	96.1	230.8	140.0			
45	117.8	282.7	120.2	111.3	267.2	127.5	104.3	250.3	134.5	97.5	234.1	141.3			
46	119.6	287.0	121.2	112.7	270.8	128.6	105.7	253.7	135.8	98.8	237.5	142.8			
48	122.8	294.2	123.0	115.8	277.8	130.7	108.7	260.9	138.1	101.8	244.3	145.4			
50	125.8	301.6	124.7	119.4	286.6	132.7	112.2	269.2	140.5	104.7	251.0	148.2			

## NOTES:

1. Chilled water flow is based on .0005 fouling factor in evaporator.
2. KW input shown is for compressor only. See ELECTRICAL DATA table for fan KW.
3. Ratings based on evaporator temperature drop of 10°F. Ratings are accurate for evaporator temperature drop from 8°F to 12°F.
4. Direct interpolation between rating points is permissible.
5. Extrapolation beyond catalog data is not permitted.
6. Blanks indicate improper full load operating point.
7. Rated in accordance with ARI standard S90-76.



## DIMENSIONS

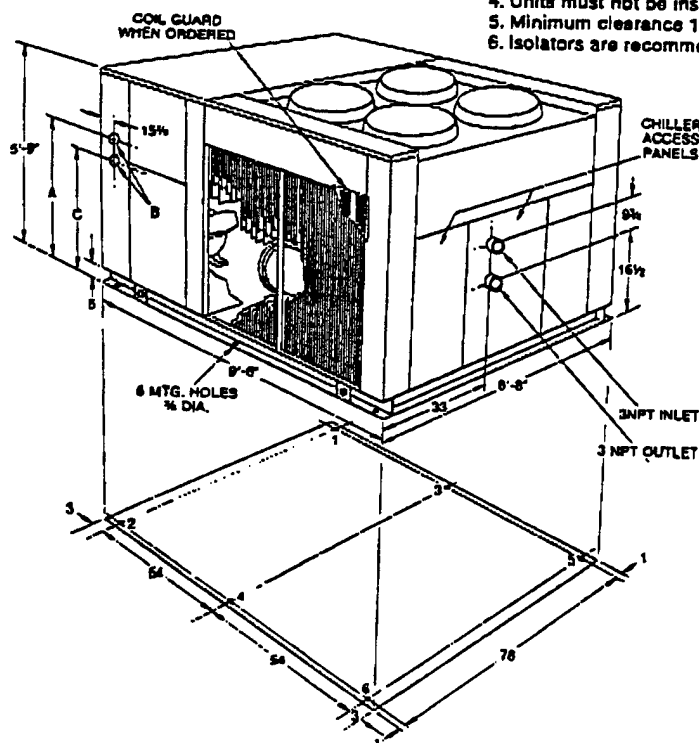
**TABLE 25-1 — Electrical Connections & Weight Distribution**

ELECTRICAL CONNECTIONS & WEIGHT DISTRIBUTION														
MODEL	ELECTRICAL CONNECTIONS			WEIGHT DISTRIBUTION										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
CGAA-400F	—	ONE 3 <sup>1</sup> / <sub>16</sub> DIA.	42 <sup>13</sup> / <sub>16</sub>	780	935	617	748	455	560					
CGAA-400M	48 <sup>13</sup> / <sub>16</sub>	TWO 2 <sup>7</sup> / <sub>16</sub> DIA.	42 <sup>13</sup> / <sub>16</sub>	780	935	617	748	455	560					

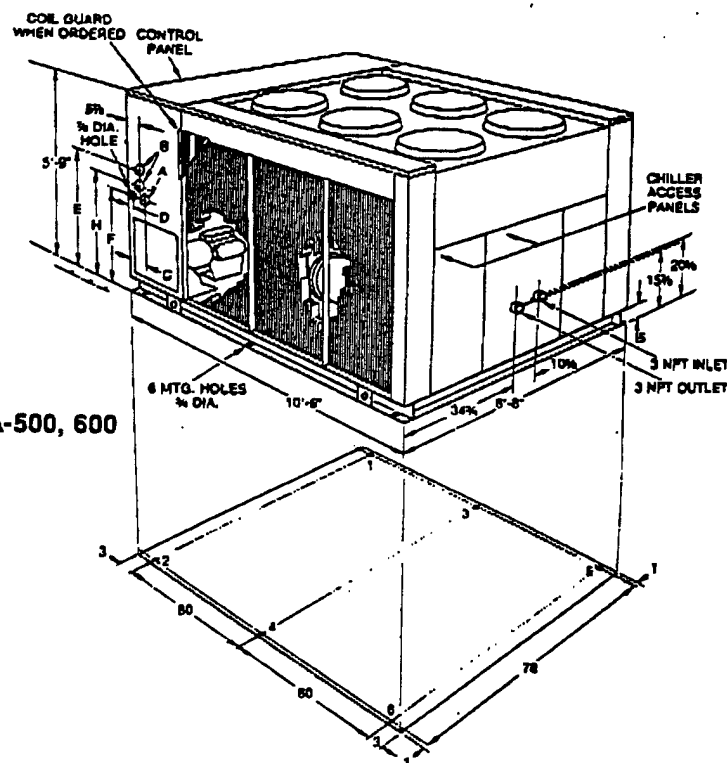
**NOTES:**

1. Minimum clearance 6 feet on coil side.
2. Minimum clearance between units is 12 feet.
3. Minimum tube-pull clearance 8 feet for evaporator and compressor, 6 feet on compressor end.
4. Units must not be installed in pit deeper than height of unit.
5. Minimum clearance 12 feet on coil sides if installed in pit.
6. Isolators are recommended when unit is roof mounted.

### CGAA-400



### CGAA-500, 600



All dimensions are approximate  
Certified dimensions available on request.

**TABLE 25-2 — CGAA 500-600, Electrical Connections & Weight Distribution**

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
CGAA-500 E	—	ONE 3 <sup>1</sup> / <sub>16</sub> DIA.	—	5 <sup>13</sup> / <sub>16</sub>	—	37 <sup>1</sup> / <sub>16</sub>	42 <sup>13</sup> / <sub>16</sub>	980	1170	730	875	490	575													
CGAA-500 M	1 <sup>1</sup> / <sub>16</sub> DIA.	TWO 2 <sup>7</sup> / <sub>16</sub> DIA.	7 <sup>1</sup> / <sub>16</sub>	3 <sup>13</sup> / <sub>16</sub>	48 <sup>13</sup> / <sub>16</sub>	37 <sup>13</sup> / <sub>16</sub>	42 <sup>13</sup> / <sub>16</sub>	905	1080	684	818	461	552													
CGAA-600 M	1 <sup>1</sup> / <sub>16</sub> DIA.	TWO 2 <sup>7</sup> / <sub>16</sub> DIA.	7 <sup>1</sup> / <sub>16</sub>	3 <sup>13</sup> / <sub>16</sub>	48 <sup>13</sup> / <sub>16</sub>	37 <sup>13</sup> / <sub>16</sub>	42 <sup>13</sup> / <sub>16</sub>	945	1132	720	885	495	593													

**NOTES:**

1. Minimum clearance 6 feet on coil side.
2. Minimum clearance between units is 12 feet.
3. Minimum tube-pull clearance 7 feet at evaporator end.
4. Units must not be installed in pit deeper than height of unit.
5. Minimum clearance 12 feet on coil sides if installed in pit.
6. Isolators are recommended when unit is roof mounted.

## CARTER & BURGESS COST ESTIMATING ANALYSIS

PROJECT NAME: FORT SAM HOUSTON EEAP

PROJECT NO: 91109912F

PROJECT LOCATION: SAN ANTONIO, TEXAS

ESTIMATOR: S.P. CLARK

SUBMITTAL:	35.0%
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35.0%

DATE: 26-Oct-93

26-Oct-93

ECO NO/ BUILDING: IV. D. 1) / BLDG 2399

CHECKED BY: DJY

[illegible]

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2399 - ECO IV. D. 1) - REPLACE CHILLER W/ HIGHER EFF/CFC FREE CHILLER  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$328,093		
B. SIOH	\$18,045		
C. DESIGN COST	\$19,686		
D. TOTAL COST (1A+1B+1C)	\$365,824		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$365,824

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	3160.8	\$33,346	14.65	\$488,525
B. DIST			\$0	17.70	\$0
C. RESID			\$0	20.99	\$0
D. NG	\$3.31	0.00	\$0	20.60	\$0
E. PPG			\$0	13.59	\$0
F. COAL			\$0	16.32	\$0
G. SOLAR			\$0	13.59	\$0
H. GEOTH			\$0	13.59	\$0
I. BIOMA			\$0	13.59	\$0
J. REFUS			\$0	13.59	\$0
K. WIND			\$0	13.59	\$0
L. OTHER			\$0	13.59	\$0
M. DEMAND SAVINGS			\$21,280	13.59	\$289,195
N. TOTAL		3160.8	\$54,626		\$777,721

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$0  
 1. DISCOUNT FACTOR (TABLE A) \_\_\_\_\_  
 2. DISCOUNTED SAVINGS/COST (3A X 3A1) \_\_\_\_\_ \$0

**LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

**B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. Chillers	\$339,208	1	0.96	\$325,640
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$339,208			\$325,640

**C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)** \$325,640

**4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :** 5.1 YEARS

**5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):** \$1,103,360

**6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ :** 3.02

**7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):** 9.9%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2399

ECO NO: IV.F.1

ECO NAME: Install make-up air supply for kitchen areas.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>41,614</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>617.0</u>	MCF/yr
Cost Savings:	<u>\$ 3,604</u>	/yr
Implementation Cost:	<u>\$ 31,268</u>	
Simple Payback:	<u>8.7</u>	Years
Savings to Investment: Ratio (SIR):	<u>2.09</u>	

#### ECO DESCRIPTION:

Currently, a 10' x 28' kitchen hood is in use which does not include make-up air supply. As a result, approximately 40% of the exhaust during cooling months is drawn from the adjacent conditioned dining room. The kitchen and dining areas are both heated during heating months and 100% of the make-up air for the hood is brought in from outside. This ECO analyzes installing a make-up air hood with 70% supply air make-up.

#### COST SAVINGS CALCULATIONS:

(Refer to following spreadsheet)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

# MODIFIED BIN METHOD CALCULATIONS

REFER TO ASHRAE 1993 FUNDAMENTALS

BLDG. NO.				44	368	407	1350	1387	1462	2399	2652
TIME OF OPERATION				6:00A 1:30P	6:00A 2:00P	7A-10P 7A-2P	4:00A 8:30P	10:00A 9:00P	9A-8:30P 9A-10:30P	5:00A 7:30P	10:00A 7:00P
DAYS/WEEK				5	5	4, 3	6	5	5, 2	7	4
DB RANGE	MID PT.	MC WB	HUMID RATIO	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.
100/104	102	74	0.0116	6.4	7.0	14.6	14.5	10.1	15.8	16.1	7.1
95/99	97	74	0.0126	59.4	64.8	139.8	139.4	97.9	152.8	153.4	67.7
90/94	92	74	0.0139	135.0	147.3	309.0	307.1	213.4	334.4	339.8	149.6
85/89	87	73	0.0143	173.8	189.6	418.5	418.7	296.3	461.3	458.6	202.9
80/84	82	72	0.0146	213.2	231.4	530.6	557.5	382.4	589.7	595.6	253.5
75/79	77	70	0.0142	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70/74	72	66	0.0123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65/69	67	61	0.0101	196.1	208.4	418.7	527.9	283.1	433.6	535.7	183.2
60/64	62	56	0.0082	161.8	172.0	346.9	437.0	235.1	359.9	443.3	151.9
55/59	57	51	0.0066	132.3	140.5	288.0	363.6	196.9	300.7	367.8	126.2
50/54	52	47	0.0057	118.4	125.4	256.0	332.4	174.6	265.8	333.0	110.6
45/49	47	43	0.0050	92.0	96.8	190.1	260.7	127.1	192.8	257.6	79.5
40/44	42	38	0.0039	72.4	75.9	138.6	198.4	88.8	135.1	195.0	56.1
35/39	37	34	0.0034	44.4	46.1	75.5	120.8	44.9	68.1	116.1	28.1
30/34	32	29	0.0028	23.0	23.8	34.9	60.3	18.9	28.8	57.4	12.0
25/29	27	25	0.0023	8.3	8.4	9.6	21.3	3.8	5.8	19.4	2.4
20/24	22	20	0.0016	2.4	2.5	3.6	6.1	2.0	3.0	5.9	1.3
15/19	17	15	0.0013	0.4	0.4	0.3	0.9	0.0	0.0	0.8	0.0
10/14	12	10	0.0009	0.2	0.2	0.1	0.4	0.0	0.0	0.4	0.0

## ASSUMPTIONS

- 1) SUMMER ROOM DESIGN: 78FDB, 50%RH
- 2) WINTER ROOM DESIGN: 70FDB, 40%RH
- 3) HUMIDITY RATIOS FOR THE SPACE BASED ON SUMMER & WINTER ROOM DESIGN TEMP.

## EQUIPMENT:

SMALL AIR COOLED CHILLER (3-25 TONS): 8.57 BTU/WATT-H  
 LARGE AIR COOLED CHILLER (25-100 TONS): 8.63 BTU/WATT-H  
 SMALL WATER COOLED CHILLER (25-100 TONS): 11.11 BTU/WATT-H  
 LARGE WATER COOLED CHILLER (> 100 TONS): 12.12 BTU/WATT-H

## SYSTEM TYPES FOR ABOVE BUILDINGS

BUILDING NUMBER	SYSTEM TYPE
44	SMALL AIR COOLED
368	SMALL AIR COOLED
407	LARGE AIR COOLED
1350	LARGE WATER COOLED
1387	SMALL AIR COOLED
1462	LARGE AIR COOLED
2399	LARGE WATER COOLED
2652	LARGE AIR COOLED

ASSUME 40% CONDITIONED AIR IS EXHAUSTED  
EXHAUST CFM=10FTx28FTx100FPM=28,000CFM  
BUILDING 2399

CFM	DB	RM	HR	OA	HR	RM	BTUH	SENS. LATENT	TOTAL	BTUH	HRS	TOTAL
											/YEAR	BTU
11200	102	78	0.0116	0.0102	290304	75891	366195		366195		16.1	5882010
11200	97	78	0.0126	0.0102	229824	130099	359923		359923		153.4	55203221
11200	92	78	0.0139	0.0102	169344	200570	369914		369914		339.8	125678146
11200	87	78	0.0143	0.0102	108864	222253	331117		331117		458.6	151837748
11200	82	78	0.0146	0.0102	48384	238515	286899		286899		595.6	170866405
11200	67	70	0.0101	0.0062	36288	211411	247699		247699		535.7	132889365
11200	62	70	0.0082	0.0062	96768	108416	205184		205184		443.3	90960632
11200	57	70	0.0066	0.0062	157248	21683	178931		178931		367.8	65813132
11200	52	70	0.0057	0.0062	217728	27104	244832		244832		333.0	90052270
11200	47	70	0.0050	0.0062	278208	65050	343258		343258		257.6	114304781
11200	42	70	0.0039	0.0062	338688	124678	463366		463366		195.0	119345808
11200	37	70	0.0034	0.0062	399168	151782	550950		550950		116.1	107435328
11200	32	70	0.0027	0.0062	459648	189728	649376		649376		57.4	75368202
11200	27	70	0.0023	0.0062	520128	211411	731539		731539		19.4	41972062
11200	22	70	0.0017	0.0062	580608	243936	824544		824544		5.9	47308212
11200	17	70	0.0013	0.0062	641088	265619	906707		906707		0.8	17624121
11200	12	70	0.0009	0.0062	701568	287302	988870		988870		0.4	5809614
TOTAL COOLING KBTU FOR THE YEAR										509468		
TOTAL HEATING KBTU FOR THE YEAR										908684		
EQUIPMENT 12.12 BTU/WATT-HR COOLING KWH										59448		

NOW 30% OF THE 11200 CFM IS EXHAUSTED  
EXHAUST CFM=10FTx28FTx100FPM=28,000CFM  
BUILDING 2399

CFM	DB	RM	HR	OA	HR	RM	BTUH	SENS. LATENT	TOTAL	BTUH	HRS	TOTAL
											/YEAR	BTU
3360	102	78	0.0116	0.0102	87091	22767	109859		109859		16.1	1784603
3360	97	78	0.0126	0.0102	68947	39030	107977		107977		153.4	16560986
3360	92	78	0.0139	0.0102	50803	60171	110974		110974		339.8	37703444
3360	87	78	0.0143	0.0102	32659	66676	99335		99335		458.6	45551324
3360	82	78	0.0146	0.0102	14515	71555	86070		86070		595.6	51259921
3360	67	70	0.0101	0.0062	10886	63423	74310		74310		535.7	39806810
3360	62	70	0.0082	0.0062	29030	32525	61555		61555		443.3	27288190
3360	57	70	0.0066	0.0062	47174	6505	53679		53679		367.8	19743940
3360	52	70	0.0057	0.0062	65318	8131	73450		73450		333.0	27015681
3360	47	70	0.0050	0.0062	83462	19515	102977		102977		257.6	34291434
3360	42	70	0.0039	0.0062	101606	37404	139010		139010		195.0	35803743
3360	37	70	0.0034	0.0062	119750	45535	165285		165285		116.1	32230598
3360	32	70	0.0027	0.0062	137894	58918	194813		194813		57.4	22610461
3360	27	70	0.0023	0.0062	156038	63423	219462		219462		19.4	12591618
3360	22	70	0.0017	0.0062	174182	73181	247363		247363		5.9	14192464
3360	17	70	0.0013	0.0062	192326	79686	272012		272012		0.8	5287236
3360	12	70	0.0009	0.0062	210470	86191	286861		286861		0.4	1742884
TOTAL COOLING KBTU FOR THE YEAR										152840		
TOTAL HEATING KBTU FOR THE YEAR										272805		
EQUIPMENT 12.12 BTU/WATT-HR COOLING KWH										17834		

PROJECT NAME: FORT SAM HOUSTON EEAP	PROJECT NO: 91109912F
PROJECT LOCATION: SAN ANTONIO, TEXAS	ESTIMATOR: C.M. JOHNSON
SUBMITTAL: 35.0%	DATE: 27 - Oct - 93
ECO NO/BUILDING: IV. F./BLDG 2399 HOOD 4	CHECKED BY: SPC

JOBNUMCE.WK1 407 27-Oct-93



# LIFE CYCLE COST ANALYSIS SUMMARY ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2399 - ECO IV. F.) - INSTALL MAKE-UP AIR SUPPLY FOR KITCHEN AREAS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER C. M. JOHNSON

## 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$28,043	
B. SIOH	\$1,542	
C. DESIGN COST	\$1,683	
D. TOTAL COST (1A+1B+1C)	\$31,268	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$0	
F. PUBLIC UTILITY COMPANY REBATE	\$0	
G. TOTAL INVESTMENT (1D-1E-1F)		\$31,268

## 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	142.03	\$1,498	14.65	\$21,952
B. DIST			\$0	17.70	\$0
C. RESID			\$0	20.99	\$0
D. NG	\$3.31	636.08	\$2,105	20.60	\$43,372
E. PPG			\$0	13.59	\$0
F. COAL			\$0	16.32	\$0
G. SOLAR			\$0	13.59	\$0
H. GEOTH			\$0	13.59	\$0
I. BIOMA			\$0	13.59	\$0
J. REFUS			\$0	13.59	\$0
K. WIND			\$0	13.59	\$0
L. OTHER			\$0	13.59	\$0
M. DEMAND SAVINGS			\$0	13.59	\$0
N. TOTAL		778.11	\$3,604		\$65,324

## 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$0  
 1. DISCOUNT FACTOR (TABLE A) \_\_\_\_\_  
 2. DISCOUNTED SAVINGS/COST (3A X 3A1) \$0

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

## **C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)**

\$0

### **4. SIMPLE PAYBACK $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :**

8.7 YEARS

### **5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):**

\$65,324

### **6. SAVINGS TO INVESTMENT RATIO (SIR) $5/1G$ :**

2.09

### **7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):**

7.9%

## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2399

ECO NO: IV.F.2

ECO NAME: Install make-up air supply for kitchen areas.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>4.776</u>	KWH/yr
Demand Savings:	<u>0</u>	KW/yr
Gas Savings:	<u>70.8</u>	MCF/yr
Cost Savings:	<u>\$ 414</u>	/yr
Implementation Cost:	<u>\$ 3.976</u>	
Simple Payback:	<u>9.6</u>	Years
Savings to Investment: Ratio (SIR):	<u>1.89</u>	

#### ECO DESCRIPTION:

Currently, a 4' x 4' kitchen hood is in use which does not include make-up air supply. As a result, approximately 40% of the exhaust during cooling months is drawn from the adjacent conditioned dining room. The kitchen and dining areas are both heated during heating months and 100% of the make-up air for the hood is brought in from outside. This ECO analyzes installing a make-up air hood with 70% supply air make-up.

#### COST SAVINGS CALCULATIONS:

(Refer to following spreadsheet)

#### IMPLEMENTATION COSTS:

(Refer to following Cost Estimate)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

# MODIFIED BIN METHOD CALCULATIONS

REFER TO ASHRAE 1993 FUNDAMENTALS

BLDG. NO.				44	368	407	1350	1387	1462	2399	2652
TIME OF OPERATION				6:00A 1:30P	6:00A 2:00P	7A-10P 7A-2P	4:00A 8:30P	10:00A 9:00P	9A-8:30P 9A-10:30P	5:00A 7:30P	10:00A 7:00P
DAYS/WEEK				5	5	4, 3	6	5	5, 2	7	4
DB RANGE	MID PT.	MC WB	HUMID RATIO	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.	HRS /YR.
100/104	102	74	0.0116	6.4	7.0	14.6	14.5	10.1	15.8	16.1	7.1
95/99	97	74	0.0126	59.4	64.8	139.8	139.4	97.9	152.8	153.4	67.7
90/94	92	74	0.0139	135.0	147.3	309.0	307.1	213.4	334.4	339.8	149.6
85/89	87	73	0.0143	173.8	189.6	418.5	418.7	296.3	461.3	458.6	202.9
80/84	82	72	0.0146	213.2	231.4	530.6	557.5	382.4	589.7	595.6	253.5
75/79	77	70	0.0142	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70/74	72	66	0.0123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65/69	67	61	0.0101	196.1	208.4	418.7	527.9	283.1	433.6	535.7	183.2
60/64	62	56	0.0082	161.8	172.0	346.9	437.0	235.1	359.9	443.3	151.9
55/59	57	51	0.0066	132.3	140.5	288.0	363.6	196.9	300.7	367.8	126.2
50/54	52	47	0.0057	118.4	125.4	256.0	332.4	174.6	265.8	333.0	110.6
45/49	47	43	0.0050	92.0	96.8	190.1	260.7	127.1	192.8	257.6	79.5
40/44	42	38	0.0039	72.4	75.9	138.6	198.4	88.8	135.1	195.0	56.1
35/39	37	34	0.0034	44.4	46.1	75.5	120.8	44.9	68.1	116.1	28.1
30/34	32	29	0.0028	23.0	23.8	34.9	60.3	18.9	28.8	57.4	12.0
25/29	27	25	0.0023	8.3	8.4	9.6	21.3	3.8	5.8	19.4	2.4
20/24	22	20	0.0016	2.4	2.5	3.6	6.1	2.0	3.0	5.9	1.3
15/19	17	15	0.0013	0.4	0.4	0.3	0.9	0.0	0.0	0.8	0.0
10/14	12	10	0.0009	0.2	0.2	0.1	0.4	0.0	0.0	0.4	0.0

## ASSUMPTIONS

- 1) SUMMER ROOM DESIGN: 78FDB, 50%RH
- 2) WINTER ROOM DESIGN: 70FDB, 40%RH
- 3) HUMIDITY RATIOS FOR THE SPACE BASED ON SUMMER & WINTER ROOM DESIGN TEMP.

## EQUIPMENT:

SMALL AIR COOLED CHILLER (3-25 TONS): 8.57 BTU/WATT-H  
 LARGE AIR COOLED CHILLER (25-100 TONS): 8.63 BTU/WATT-H  
 SMALL WATER COOLED CHILLER (25-100 TONS): 11.11 BTU/WATT-H  
 LARGE WATER COOLED CHILLER (>100 TONS): 12.12 BTU/WATT-H

## SYSTEM TYPES FOR ABOVE BUILDINGS

BUILDING NUMBER	SYSTEM TYPE
44	SMALL AIR COOLED
368	SMALL AIR COOLED
407	LARGE AIR COOLED
1350	LARGE WATER COOLED
1387	SMALL AIR COOLED
1462	LARGE AIR COOLED
2399	LARGE WATER COOLED
2652	LARGE AIR COOLED

ASSUME 40% CONDITIONED AIR IS EXHAUSTED  
EXHAUST CFM=4FTx4FTx100FPM=1600CFM  
BUILDING 2399

CFM	DB	RM	HR	OA	HR	RM	SENS. LATENT	TOTAL	HRS	TOTAL
							BTUH	BTUH	/YEAR	BTU
640	102	78	0.0116	0.0102	16589	4337	20925	16.1	336115	
640	97	78	0.0126	0.0102	13133	7434	20567	153.4	3154470	
640	92	78	0.0139	0.0102	9677	11461	21138	339.8	7181608	
640	87	78	0.0143	0.0102	6221	12700	18921	458.6	8676443	
640	82	78	0.0146	0.0102	2765	13629	16394	595.6	9763795	
640	67	70	0.0101	0.0062	2074	12081	14154	535.7	7582249	
640	62	70	0.0082	0.0062	5530	6195	11725	443.3	5197750	
640	57	70	0.0066	0.0062	8986	1239	10225	367.8	3760750	
640	52	70	0.0057	0.0062	12442	1549	13990	333.0	5145844	
640	47	70	0.0050	0.0062	15898	3717	19615	257.6	6531702	
640	42	70	0.0039	0.0062	19354	7124	26478	195.0	6819760	
640	37	70	0.0034	0.0062	22810	8673	31483	116.1	6139162	
640	32	70	0.0027	0.0062	26266	10842	37107	57.4	4306754	
640	27	70	0.0023	0.0062	29722	12081	41802	19.4	2398404	
640	22	70	0.0017	0.0062	33178	13939	47117	5.9	2703326	
640	17	70	0.0013	0.0062	36634	15178	51812	0.8	1007093	
640	12	70	0.0009	0.0062	40090	16417	56507	0.4	331978	
TOTAL COOLING KBTU FOR THE YEAR									58225	
TOTAL HEATING KBTU FOR THE YEAR									103850	
EQUIPMENT 12.12 BTU/WATT-HR COOLING KWH									6784	

NOW 30% OF THE 640 CFM IS EXHAUSTED  
EXHAUST CFM=4FTx4FTx100FPM=1600CFM  
BUILDING 2399

CFM	DB	RM	HR	OA	HR	RM	SENS. LATENT	TOTAL	HRS	TOTAL
							BTUH	BTUH	/YEAR	BTU
190	102	78	0.0116	0.0102	4925	1287	6212	16.1	99784	
190	97	78	0.0126	0.0102	3899	2207	6106	153.4	936483	
190	92	78	0.0139	0.0102	2873	3403	6275	339.8	2132040	
190	87	78	0.0143	0.0102	1847	3770	5617	458.6	2575619	
190	82	78	0.0146	0.0102	821	4046	4867	595.6	2898627	
190	67	70	0.0101	0.0062	616	3586	4202	535.7	2250980	
190	62	70	0.0082	0.0062	1642	1839	3481	443.3	1543082	
190	57	70	0.0066	0.0062	2668	368	3035	367.8	1116473	
190	52	70	0.0057	0.0062	3694	460	4153	333.0	1527672	
190	47	70	0.0050	0.0062	4720	1104	5823	257.6	1939099	
190	42	70	0.0039	0.0062	5746	2115	7861	195.0	2024616	
190	37	70	0.0034	0.0062	6772	2575	9346	116.1	1822564	
190	32	70	0.0027	0.0062	7798	3219	11016	57.4	1278568	
190	27	70	0.0023	0.0062	8824	3586	12410	19.4	712028	
190	22	70	0.0017	0.0062	9850	4138	13988	5.9	802550	
190	17	70	0.0013	0.0062	10876	4506	15382	0.8	298981	
190	12	70	0.0009	0.0062	11902	4874	16775	0.4	98556	
TOTAL COOLING KBTU FOR THE YEAR									17286	
TOTAL HEATING KBTU FOR THE YEAR									30830	
EQUIPMENT 12.12 BTU/WATT-HR COOLING KWH									2017	

PROJECT NAME: FORT SAM HOUSTON EEAP	PROJECT NO: 91109912F
PROJECT LOCATION: SAN ANTONIO, TEXAS	ESTIMATOR: C.M. JOHNSON
SUBMITTAL: 35.0%	DATE: 27-Oct-93
ECO NO/BUILDING: IV. F./BLDG 2399 HOOD 5	CHECKED BY: SPC

JOBNUMCE.WK1 413 27-Oct-93

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2399 - ECO IV. F.) - INSTALL MAKE-UP AIR SUPPLY FOR KITCHEN AREAS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 20 PREPARER C. M. JOHNSON

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$3,566		
B. SIOH	\$196		
C. DESIGN COST	\$214		
D. TOTAL COST (1A+1B+1C)	\$3,976		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$3,976

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	16.3	\$172	14.65	\$2,519
B. DIST			\$0	17.70	\$0
C. RESID			\$0	20.99	\$0
D. NG	\$3.31	73.02	\$242	20.60	\$4,979
E. PPG			\$0	13.59	\$0
F. COAL			\$0	16.32	\$0
G. SOLAR			\$0	13.59	\$0
H. GEOTH			\$0	13.59	\$0
I. BIOMA			\$0	13.59	\$0
J. REFUS			\$0	13.59	\$0
K. WIND			\$0	13.59	\$0
L. OTHER			\$0	13.59	\$0
M. DEMAND SAVINGS			\$0	13.59	\$0
N. TOTAL		89.32	\$414		\$7,498

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-) \$0  
 1. DISCOUNT FACTOR (TABLE A) \_\_\_\_\_  
 2. DISCOUNTED SAVINGS/COST (3A X 3A1) \_\_\_\_\_ \$0

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+) COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4) \$0

4. SIMPLE PAYBACK  $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ : 9.6 YEARS

5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C): \$7,498

6. SAVINGS TO INVESTMENT RATIO (SIR)  $5/1G$ : 1.89

7. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.4%



## ENERGY CONSERVATION ANALYSIS

### ENERGY CONSERVATION OPPORTUNITIES (ECO's) - BUILDING NO. 2399

ECO NO: VII D & IX A, B, C, D

ECO NAME: Improve lighting efficiency.

#### SUMMARY DATA (DEPENDENT):

KWH Savings:	<u>18.019</u>	KWH/yr
Demand Savings:	<u>28.42</u>	KW/yr
Gas Savings:	<u>n/a</u>	MCF/yr
Cost Savings:	<u>\$ 1,574.00</u>	/yr
Implementation Cost:	<u>\$ 8,895</u>	
Simple Payback:	<u>5.7</u>	Years
Savings to Investment: Ratio (SIR):	<u>2.00</u>	

#### ECO DESCRIPTION:

Currently, low efficiency lighting systems are in use. This ECO will update the lighting systems to improve efficiency while maintaining or increasing the current light levels. The existing lighting system and proposed retrofit action are as follows:

QTY	FIXTURE TYPE	ACTION
6	2-Lamp, 2' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
158	2-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
10	4-Lamp, 4' Fluor.	Retrofit w/T8 lamps and electronic ballasts.
2	Incandescent track	Retrofit with compact fluor. lamps.
10	Incandescent hood	None.
2	Incandescent exit	Replace w/LED exit fixture.

#### COST SAVINGS CALCULATIONS:

(Refer to following Flex Output)

$$\begin{aligned}\text{Demand Savings} &= (18.392\text{ KW} - 16.024\text{ KW})(4\text{ mo.} \times \$7.50/\text{KW} + 8\text{ mo.} \times \$6.25/\text{KW}) \\ &= \$189.44/\text{yr}\end{aligned}$$

#### IMPLEMENTATION COSTS:

(Refer to following Flex Output and Lighting Implementation Cost located in Appendix E)

#### LIFE CYCLE COST ANALYSIS:

(Refer to following ECIP Life Cycle Cost Summary)

Project Name (*Base)	Annual Energy kWh	Net Present Value \$	Present Value Total LCC \$	Annual Value Total LCC \$	Annual Energy Savings kWh	Savings Invest. Ratio (SIR)	Levelized Energy Cost cnts/kWh	Total Initial Cost \$	Present Value Maint LCC \$	Present Value Energy LCC \$	Annual Value Maint LCC \$	Annual Value Energy LCC \$
BLD2399A	87729	24737	217727	16021	12964	3.101	2.451	7978	13427	196323	988	14446
*BLD2399B	100693	0	242464	17841	0	0.000	0.000	0	17086	225377	1257	16584

Project Description: FT SAM HOUSTON EEAP

File Names	Case Description
BLD2399A	POST RETROFIT CONDITION
BLD2399B	EXISTING CONDITIONS

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399A.WBR  
 Date: 10/16/1993

Lighting Annual : 87729 kWh  
 Lighting Capacity : 16.024 kW  
 Annual Cooling Effect : 121686 kWh  
 Annual Heating Effect : 12533 kWh  
 Total Surveyed Floor Area: 14648 SqFt  
 Percent Survey Completed : 1464800 %  
 Lighting Power Density : 1.094 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	7978	86676	13427	111797	-2151	217727
AVLCC \$	587	6378	988	8226	-158	16021

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| Lighting Level Comparison Report |

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Project: FT SAM HOUSTON EEAP

File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399A.LLR

Date: 10/16/1993

Room						
Foot Candles	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calculated	36.2	14.4	25.5	9.60	4-stor	3-scullyery
Measured	31.2	5.9	18.8	9.03	2-kitchen	4-stor
Required	50.0	5.0	32.0	24.65	2-kitchen	1-dining

Foot Candle Comparison	MAX	MIN	AVG	SDEV	MAX Room	MIN Room
Calc - Req.	31.2	-35.6	-6.5	33.94	4-stor	3-scullyery
Meas - Req.	15.3	-33.1	-13.2	20.85	1-dining	5-kitchen

Lighting System Survey Summary  
One Page for Each Defined System

Project: FT SAM HOUSTON EEAP  
File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399A.LSR  
Date: 10/16/1993

System Number: 1      Descrip: 4 lamp, 2x4 lay-in

Rooms Served: 1  
Floor Area: 7192 SqFt  
Possible kW: 8.352  
Working kW: 8.352  
Capacity kW: 8.352  
Lighting: 45727 Annual kWh  
Heating: 6532 Annual kWh  
Cooling: 63423 Annual kWh  
Op Hours/Year: 5475 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 69.0 Months  
Power Density: 1.161 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	72	288	72.0
Working	72	288	72.0
Capacity	72	288	72.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	45178	5225	58268	-1121	111366
AVLCC \$	3324	384	4287	-82	8195

System Number: 2      Descrip: 2x2 rec. fluor.

Rooms Served: 2  
Floor Area: 11000 SqFt  
Possible kW: 0.377  
Working kW: 0.377  
Capacity kW: 0.377  
Lighting: 2063 Annual kWh  
Heating: 295 Annual kWh  
Cooling: 2861 Annual kWh  
Op Hours/Year: 5475 Annual Hrs  
Relamp Method: Spot  
Relamp Time : 69.0 Months  
Power Density: 0.034 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	6	12	6.0
Working	6	12	6.0
Capacity	6	12	6.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	2038	303	2629	-51	5169
AVLCC \$	150	22	193	-4	380

System Number: 3      Descrip: 8' track w/PL

Rooms Served: 1  
 Floor Area: 7192 SqFt  
 Possible kW: 0.048  
 Working kW: 0.048  
 Capacity kW: 0.048  
 Lighting: 263 Annual kWh  
 Heating: 38 Annual kWh  
 Cooling: 372 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 31.0 Months  
 Power Density: 0.007 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	2	2.0
Working	2	2	2.0
Capacity	2	2	2.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	260	305	343	-6	945
AVLCC \$	19	22	25	-0	70

System Number: 4      Descrip: 1x4 rec. fluor.

Rooms Served: 3  
 Floor Area: 6592 SqFt  
 Possible kW: 5.087  
 Working kW: 5.087  
 Capacity kW: 5.087  
 Lighting: 27850 Annual kWh  
 Heating: 3979 Annual kWh  
 Cooling: 38628 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 69.0 Months  
 Power Density: 0.772 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	81	162	81.0
Working	81	162	81.0
Capacity	81	162	81.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	27516	4033	35488	-683	69676
AVLCC \$	2025	297	2611	-50	5127

System Number: 5      Descrip: lensed gasketed hood fixture

Rooms Served: 1  
 Floor Area: 3808 SqFt  
 Possible kW: 1.000  
 Working kW: 1.000  
 Capacity kW: 1.000  
 Lighting: 5475 Annual kWh  
 Heating: 782 Annual kWh  
 Cooling: 7594 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 1.6 Months  
 Power Density: 0.263 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	10	0.0
Working	10	10	0.0
Capacity	10	10	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5409	2835	6977	-134	15103
AVLCC \$	398	209	513	-10	1111

System Number: 6      Descrip: 4' wrap

Rooms Served: 1  
 Floor Area: 864 SqFt  
 Possible kW: 1.160  
 Working kW: 1.160  
 Capacity kW: 1.160  
 Lighting: 6351 Annual kWh  
 Heating: 907 Annual kWh  
 Cooling: 8809 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 69.0 Months  
 Power Density: 1.343 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	40	10.0
Working	10	40	10.0
Capacity	10	40	10.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	6275	726	8093	-156	15468
AVLCC \$	462	53	595	-11	1138



Room-By-Room Summary Report

Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399A.RRR  
 Date: 10/16/1993

Room Name	Floor	#	Total Area	SYSTEM1	Work Watts	Pot. Watts	Watt sqft	SYSTEM2	Work Watts	Pot. Watts	Watt sqft	SYSTEM3	Work Watts	Pot. Watts	Watt sqft	Watt Meas.	Calc.	Req.
1-dining	1	1	7192	300 4 lamp, 2x 6 1x4 rec. f	8352	8352	1.16	2x2 rec. f	314	314	0.04	8' track w	8714	8714	1.21	20.3	34.8	5.0
2-kitchen	1	1	3808	6 1x4 rec. f	3014	3014	0.79	lensed gas	1000	1000	0.26	2x2 rec. f	4077	4077	1.07	31.2	22.1	50.0
3-scullery	1	1	1200	2 1x4 rec. f	754	754	0.63						754	754	0.63	19.5	14.4	50.0
4-stor	1	1	864	0 4' wrap	1160	1160	1.34						1160	1160	1.34	5.9	36.2	5.0
5-kitchen	1	1	1584	6 1x4 rec. f	1319	1319	0.83						1319	1319	0.83	16.9	19.7	50.0

Total Rooms : 5  
 Total Area Sqft : 14648  
 Total People : 314  
 Total Working kW : 16.024  
 Total Potential kW : 16.024  
 Power Density w/sqft : 1.094

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| Whole Building Summary Report |

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399B.WBR  
 Date: 10/16/1993

Lighting Annual : 100693 kWh  
 Lighting Capacity : 18.392 kW  
 Annual Cooling Effect : 139704 kWh  
 Annual Heating Effect : 14385 kWh  
 Total Surveyed Floor Area: 14648 SqFt  
 Percent Survey Completed : 1464800 %  
 Lighting Power Density : 1.256 W/sqft

Costs	Initial	Energy	Maint.	Cooling	Heating	Total
-----	-----	-----	-----	-----	-----	-----
PVLCC \$	0	99485	17086	128361	-2468	242464
AVLCC \$	0	7320	1257	9445	-182	17841

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Lighting System Survey Summary

One Page for Each Defined System

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Project: FT SAM HOUSTON EEAP  
 File: H:\JOB\911099\12F\ELECT\FLEX\OUT\2399\BLD2399B.LSR  
 Date: 10/16/1993

System Number: 1      Descrip: 4 lamp, 2x4 lay-in

=====

Rooms Served: 1  
 Floor Area: 7192 SqFt  
 Possible kW: 6.720  
 Working kW: 6.720  
 Capacity kW: 6.720  
 Lighting: 36792 Annual kWh  
 Heating: 5256 Annual kWh  
 Cooling: 51030 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 69.0 Months  
 Power Density: 0.934 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	70	140	35.0
Working	70	140	35.0
Capacity	70	140	35.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	36350	4655	46882	-902	86986
AVLCC \$	2675	343	3450	-66	6401

System Number: 2      Descrip: 2x2 rec. fluor.

=====

Rooms Served: 2  
 Floor Area: 11000 SqFt  
 Possible kW: 0.675  
 Working kW: 0.579  
 Capacity kW: 0.675  
 Lighting: 3698 Annual kWh  
 Heating: 528 Annual kWh  
 Cooling: 5130 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 41.4 Months  
 Power Density: 0.053 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	7	14	7.0
Working	6	12	6.0
Capacity	7	14	7.0
Disconnected	0	0	0.0
Broken/Burned	1	0	1.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	3654	784	4713	-91	9060
AVLCC \$	269	58	347	-7	667

System Number: 3      Descrip: 8' track w/incand.

Rooms Served: 1  
 Floor Area: 7192 SqFt  
 Possible kW: 0.300  
 Working kW: 0.300  
 Capacity kW: 0.300  
 Lighting: 1643 Annual kWh  
 Heating: 235 Annual kWh  
 Cooling: 2323 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 4.4 Months  
 Power Density: 0.042 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	2	6	0.0
Working	2	6	0.0
Capacity	2	6	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	1623	1022	2145	-40	4750
AVLCC \$	119	75	158	-3	349

System Number: 4      Descrip: 1x4 rec. fluor.

Rooms Served: 3  
 Floor Area: 6592 SqFt  
 Possible kW: 7.776  
 Working kW: 7.776  
 Capacity kW: 7.776  
 Lighting: 42574 Annual kWh  
 Heating: 6082 Annual kWh  
 Cooling: 59049 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 69.0 Months  
 Power Density: 1.180 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	81	162	81.0
Working	81	162	81.0
Capacity	81	162	81.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	42063	6460	54249	-1044	101728
AVLCC \$	3095	475	3992	-77	7485

System Number: 5      Descrip: lensed gasketed hood fixture

Rooms Served: 1  
 Floor Area: 3808 SqFt  
 Possible kW: 1.000  
 Working kW: 1.000  
 Capacity kW: 1.000  
 Lighting: 5475 Annual kWh  
 Heating: 782 Annual kWh  
 Cooling: 7594 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 1.6 Months  
 Power Density: 0.263 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	10	0.0
Working	10	10	0.0
Capacity	10	10	0.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	5409	2835	6977	-134	15086
AVLCC \$	398	209	513	-10	1110

System Number: 6      Descrip: 4' wrap

Rooms Served: 1  
 Floor Area: 864 SqFt  
 Possible kW: 1.920  
 Working kW: 1.920  
 Capacity kW: 1.920  
 Lighting: 10512 Annual kWh  
 Heating: 1502 Annual kWh  
 Cooling: 14580 Annual kWh  
 Op Hours/Year: 5475 Annual Hrs  
 Relamp Method: Spot  
 Relamp Time : 69.0 Months  
 Power Density: 2.222 Watts/SqFt

Equipment	Fixtures	Lamps	Ballasts
Possible	10	40	10.0
Working	10	40	10.0
Capacity	10	40	10.0
Disconnected	0	0	0.0
Broken/Burned	0	0	0.0

Costs	Energy	Maint.	Cooling	Heating	Total
PVLCC \$	10386	1330	13395	-258	24853
AVLCC \$	764	98	986	-19	1829

# LIFE CYCLE COST ANALYSIS SUMMARY

## ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: FORT SAM HOUSTON REGION NO. 3 PROJECT NO. 91109912F  
 PROJECT TITLE: FORT SAM HOUSTON DINING FACILITIES EEAP FISCAL YEAR 1994  
 DISCRETE PORTION NAME: BUILDING 2399 - ECO VII D. & IX A, B., C., D. - LIGHTING IMPROVEMENTS  
 ANALYSIS DATE: NOVEMBER 1, 1993 ECONOMIC LIFE 15 PREPARER S. P. CLARK

### 1. INVESTMENT COSTS:

A. CONSTRUCTION COST	\$7,978		
B. SIOH	\$439		
C. DESIGN COST	\$479		
D. TOTAL COST (1A+1B+1C)	\$8,895		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		\$0	
F. PUBLIC UTILITY COMPANY REBATE		\$0	
G. TOTAL INVESTMENT (1D-1E-1F)			\$8,895

### 2. ENERGY SAVINGS (+)/COST(-):

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS: NOVEMBER 4, 1992

ENERGY SOURCE	COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	\$10.55	44.25	\$467	11.77	\$5,495
B. DIST			\$0	13.83	\$0
C. RESID			\$0	16.15	\$0
D. NG	\$3.31	0.00	\$0	15.34	\$0
E. PPG			\$0	11.12	\$0
F. COAL			\$0	12.82	\$0
G. SOLAR			\$0	11.12	\$0
H. GEOTH			\$0	11.12	\$0
I. BIOMA			\$0	11.12	\$0
J. REFUS			\$0	11.12	\$0
K. WIND			\$0	11.12	\$0
L. COOLING	\$10.55	61.5	\$649	11.12	\$7,215
M. DEMAND SAVINGS			\$189	11.12	\$2,107
N. TOTAL		105.75	\$1,305		\$14,816

### 3. NON ENERGY SAVINGS (+) OR COST (-):

A. ANNUAL RECURRING (+/-)	\$269		
1. DISCOUNT FACTOR (TABLE A)		11.1	
2. DISCOUNTED SAVINGS/COST (3A X 3A1)			\$2,986

# **LIFE CYCLE COST ANALYSIS SUMMARY** **ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)**

## **B. NON RECURRING SAVINGS (+) OR COST(-)**

ITEM	SAVINGS(+) COST(-)(1)	YEAR OF OCCUR.(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS(+)COST(-)(4)
a. N/A	\$0	1	0.96	\$0
b. N/A	\$0	2	0.92	\$0
c. N/A	\$0	3	0.89	\$0
d. N/A	\$0	4	0.85	\$0
e. N/A	\$0	5	0.82	\$0
f. N/A	\$0	6	0.79	\$0
g. N/A	\$0	7	0.76	\$0
h. N/A	\$0	8	0.73	\$0
i. N/A	\$0	9	0.7	\$0
j. N/A	\$0	10	0.68	\$0
k. N/A	\$0	11	0.65	\$0
l. N/A	\$0	12	0.62	\$0
m. N/A	\$0	13	0.6	\$0
n. N/A	\$0	14	0.58	\$0
o. N/A	\$0	15	0.56	\$0
p. TOTAL	\$0			\$0

## **C. TOTAL NON ENERGY DISCOUNTED SAVINGS (3A2 + 3Bp4)**

\$2,986

## **4. SIMPLE PAYBACK $1G/(2N3+3A+(3Bp1/ECONOMIC\ LIFE))$ :**

5.7 YEARS

## **5. TOTAL NET DISCOUNTED SAVINGS (2N5+3C):**

\$17,802

## **6. SAVINGS TO INVESTMENT RATIO (SIR) $5/1G$ :**

2.00

## **7. ADJUSTED INTERNAL RATE OF RETURN (AIRR):**

8.9%